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STUDIES IN PHONETICS AND PHONOLOGY

Studies in Phonetics and Phonology

(WITH SPECIAL REFERENCE TO DOGRI)

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Introductory Notes

The present work deals with some selected problems of Dogri phonetics and phonology. Chapter 1 contains a general introduction. Chapter 2 contains a formant analysis of oral vowels (2.3), a discussion of the distinctive features of vowels, in particular the relative constancy of the concomitant features length and centralization (2.4), a statement of the distribution of vowel phonemes with a discussion of the occurence of peripheral (Long) vowels before geminated consonants (2.5), and a discussion of the phonological interpretation and the phonetic manifestation of pairs of the type (ˈgəlɑ:/ gəlɑ:) as a difference in length or stress. Chapter 3 treats the problems of consonant gemination and consonant weakening with an account of the historical background (3.2), and a discussion of the relation to syllable division (3.3) and of the interpretation of one of the grades as basic (3.4). 3.5 and 3.6 deal with the phonetic manifestation of consonant gemination and weakening, respectively. Chapter 4 deals with word tones in Dogri.

This study was undertaken at the Institute of Phonetics, University of Copenhagen, under the supervision of Professor Eli Fischer-Jørgensen and was supported by a grant from the Danish Ministry of Education. I am very grateful to Professor Eli Fischer-Jørgensen for her able guidance and for her keen interest in the completion of the project. Thanks are also due to Professor Jørgen Rischel (Institute of Linguistics), and to

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Contents

Chapter One

Introduction

1.1. The ancient Indian Grammarian and Phonetician Pāṇini, well acquainted with processes involved in the production of speech, had explained the complexity of these processes in a very simple way more than two thousands years ago.

"The soul apprehending things with the intellect inspires the mind with a desire to speak; the mind then excites the bodily fire which in its turn impels the breath. The breath circulating in the lungs is forced upwards and impinging upon the head, reaches the speech-organs and gives rise to speech-sounds." (Translated by Allan from Paṇinīya Śikṣā in Phonetics in Ancient India 1953 P. 21).[1]

Modern phoneticians do not differ much from Pāṇini when they describe these processes involved in the production of speech. J.D.M. Laver in "Phonetics and the Brain" in Work in Progress No. 2 department of Phonetics, University of Edinburgh says almost the same. "There seem to be three stages as a logical minimum in the production of an utterance. These three stages are: (a) The selection of the appropriate semantic content of the message or the ideation stage; (b) the organization of the neural programme of the grammatical, lexical, phonological and phonetic characteristics of the selected

1. आत्मा बुद्ध्या समेत्यार्थान् मनो युङ्क्ते विवक्षया ।
मनः कायाग्निमाहन्ति स प्रेरयति मारुतम् ।। पाणिनिशिक्षा 3

message, or the neurolinguistic programme stage; (c) the temporally-ordered myodynamic performance of the neurolinguistic programme, or the myodynamic performance stage".

The Ist stage here is the same as represented by Pāṇini's आत्मा बुद्ध्या समेत्यार्थान् and the second stage of neurolinguistic programming is expressed by Pāṇini by the expression मनो युङ्क्ते विवक्षया. Then comes the third stage when motor commands flow out through motor nerves to various muscles. This firing of motor units is the same as मनो कायाग्निमाहन्ति. This neuromuscular phase involving contraction of muscles is followed by various postures and movements of speech organs like the lungs, the larynx, the tongue, with which these muscles are connected. The vocal tract from the lungs to the lips is turned by these postures and movements into a series of tubes. The shapes and sizes go on changing. The air flows through the vocal tract or the tube of a particular size and shape at a particular point of time. While it flows out, it is disturbed in such a way that the disturbance is perceived by sense of hearing. Sounds are thus generated through disturbance of the surrounding air by means of speech organs. Postures and movements of organs by themselves do not produce sounds, they only disturb the air flow which gives rise to a particular sound. As it was not easy to describe the real nature of the sound i.e. disturbance of the air, the sounds were described on the basis of the movements of the organs involved in their production because these one could see with unaided eye. But now in the later half of the 20th century, with the introduction of modern sound electronic devices like Oscilloscope and the spectograph, it has become possible to make oscilloscope—analysis of sounds. We speak for communicating with a listener and the listener listens the physical sound wave. Hence the importance of the study of acoustic phase of speech cannot be ignored, though we cannot underestimate the importance of articulatory phonetics which is still the easiest practical way of describing and learning speech sounds.

1.2. Acoustically the sounds differ from one another in three aspects; pitch, loudness and quality. There are many

good books dealing with acoustics of speech like Ladefoged's "Elements of Acoustic Phonetics" and Jokobson, Fant and Halle's "Preliminaries to speech analysis". Readers are referred to these works for detailed knowledge of acoustics. Here I give a very brief idea of the sound wave for those who might not have had its previous knowledge so that the terms used in this monograph be clear to them.

Whenever a desire is felt within to express, the mind comes in touch with the soul. The expression however, presupposes the cognition of similar sounds. This desire is followed by efforts which create a movement in the internal air which proceeds upwards and strikes the vocal apparatus. This creates disturbance in the surrounding air. We can easily understand this through an example of disturbance of water. If we throw a small stone in a pond of still water. At first, we find that a very small area of the pond is disturbed but then the waves move further, one wave creating the second wave and the second creating the third one. These go on with lesser velocity however. In the same way any vibrating source displaces the surrounding air molecules which move back and forth becoming alternately more dense and then more dispersed. Each molecule while going forward pushes another molecule which now swings into oscillation and pushes the next molecule. Thus a wave of alternate compression and dispersion moves outwards from the vibrating source. A single oscillation from negative pressure to positive and then back to negative is called a *cycle*.

1.3. *Frequency* is the number of cycles completed in one second. This is mentioned as CPS or Hz. The variations in the pitch of a sound depend on the variations of frequency. The smaller the frequency the lower the pitch, the greater the frequency the higher the pitch. Loudness of a sound depends on the size of the variations in air pressure that occur. The average frequency of deep voiced man is around 100 Hz, that of a woman is around 200 Hz and that of a child is even more i.e. vocal chords of a man vibrate 100 times a second and those of a woman 200 times a second approximately.

1.4. As regards the *quality* of a vowel sound i.e. whether it will be heard as i or e or u or o etc., depends on which

pitches does it contain. In a simple way we can say that a vowel sound contains a number of different pitches simultaneously. There is the pitch at which it is actually spoken i.e. fundamental frequency or the first harmonic and the overtone pitches that give it its distinctive quality. These characteristic overtones are called the formants of the vowels and are result of the different ways in which the air in the vocal tract viberates. Every time the vocal chords open and close, the air is pushed up from the lungs. This air gets into vibration the air in the vocal tract. Depending on the shape of the vocal tract at that time, the air in the vocal tract viberates at a number of different frequencies simultaneously. The vowel quality is the result of these resonant frequencies produced by a particular vocal tract shape, superimposed on the fundamental frequency produced by the vocal chords. If the glottis opens 100 times a second, the fundamental frequency will be 100 Hz. The vocal tract above the glottis acts as a resonance tube. Generally in a uniform tube the resonant frequency of a sound is four times the length of the tube. But the vocal tract is not a uniform tube. It is constantly changing in shape and is capable of producing resonances of various frequencies

The vowels are recognised by two characteristic pitches or formants. Formant one i.e. the lower one goes up for the front vowels and goes down for the back vowels. The second formant, which is higher of the two, goes downwards throughout the series in i e ɛ oe ɑ ɔ o u. The first formant is inversely related to vowel hight i.e. it increases when one speaks a low vowel and decreases when one speaks a high vowel.

The distance between two formants is related with the degree of backness. The distance is more in the case of front vowels, or we can say that lip-rounding decreases the frequencies of the higher formants.

1.5. The acoustic structure of consonants is not so simple as that of the vowels. Instead of regular tones the consonants are made by bursts of random noise. The Ś S X consist of noise only. The noise occurs at the highest frequencies in the case of Ś, at slightly lower frequencies in the case of S and at still lower frequencies in the case of X. Nasal sounds have a

formant structure similar to that of a vowel. As regards other consonants, the small burst of noise is there but there is hardly any difference between the noises of many consonants. The consonants are characterized by the shape of formants of vowels in their neighbourhood which show changes in accordance with the particular shape of the vocal tract at the moment of the release of the consonant. Experiments have been made in this respect and it was found that if we speak *bad* and *gad* and then cutting the tape of the vowel portion change one for the other, the consonant also changes. So acoustically the consonants depend on the vowels in their neighbourhood. The starting point of the formant of the neighbouring vowel changes according to the consonant and that starting point is called the locus. Thus in the case of velars the locus of the 2nd formant is usually high and there is common origin of 2nd and third formants but in the case of bilabials the locus of the 2nd formant and that of the 3rd formant are comparatively low. In the case of retroflex sounds, the third and the forth formants are lowered.

Chapter Two

Some Problems of Dogri Phonetics and Phonology

Previous Treatments

Dogri belongs to the Indo-Aryan Language family and is spoken in the Jammu Province of Jammu and Kashmir State in India. According to the Census of India 1981, it has nearly 1,500,000 speakers. Grierson in "Linguistic Survey of India" Vol. IX (1916) has given a brief description of Dogri and has grouped it with Panjabi. Gauri Shankar (1931) has given a description of Dogri with a small vocabulary and four pages of connected text in phonetic transcription. The monograph points out some linguistic phenomena in which Dogri differs from Panjabi and lists a number of words which have different phonetic realizations in Dogri and Panjabi, but does not specify which sounds are phonemically distinct. In 1965 appeared a Dogri grammar in Hindi, written by Bansilal Gupta (1965), which gives a brief account of Dogri sounds. A more detailed description of Dogri has been given by Ujjal Singh Bahri in his paper "Phonology of Dogri" (1969). The paper is based on an auditory study of tape recordings made in various parts of Jammu Province. He gives a detailed articulatory, auditory, and phonological description of Dogri sounds. His description, however, differs from the present description on some points, which will be discussed in later paragraphs.

I have chosen to treat some selected problems of Dogri phonology and phonetics more thoroughly, and mention others very briefly. The subjects treated in more detail are the system of oral vowels, the problems of quantity and stress, consonant gemination and consonant weakening. The tonal system and its phonetic manifestation has also been treated.

2.1. Informants and material for the present investigation

The phonetic part of the present work is based on tape recordings by six informants, three male (RN, SL, and SD, aged 62, 30, and 32, respectively) and three female (CS, AS, and VG, aged 40, 23, and 48, respectively). VG is the author. They all speak Dogri as their first language.

The recordings of the first five informants were made in the studio of Radio Kashmir of Jammu, on a professional tape recorder at a speed of 7½ i. p. s., whereas the recordings of VG were made in a sound-treated room at the Institute of Phonetics in Copenhagen in the year 1979.

The recordings consisted of lists of words which were all spoken in a carrier sentence, generally: ᴜs ... sᴜṇe:*a*: 'he ... heard', but in some cases: jᵊs ... k ə r ə d i : h i : 'Jas was ... doing' (used for verbs). Moreover, the subjects read a short connected text composed by the author, and a story. Each of the word lists was read five times by each informant. AS, however, only read the lists three times and she did not speak all the words, so she has been left out in various averages.

List I consisted of the following words, quasi-randomized, as shown[1]:

(1) The transcription used in this list and in the rest of the book is a phonemic notation with some redundancy, e.g. both vowel quality (centralization) and vowel length are indicated (see the discussion in section 2.) (ə) in parentheses indicates an optional sound. It is always possible to pronounce an [ə] after a final consonant.

təˈla:	ləˈɖa:	ˈgəl (ə)	ˈda:bba:	ɖəpph (ə)	gəɟ (ə)
gəˈla:	kəˈra:	ləˈga:	ɟəd (ə)	tuˋ:ph	ˈcəppəl(ə)
pəˈla:	ˈgəla:	la:g (ə)	ˈɟa:ddi:	ˈtəˋppha:	ˈgəɟɟ (ə)
ləˈka:	ˈpəla:	gəll (ə)	ɟədd (ə)	ˈməṭṭha:	ˈkəṭəna
bəˈsa:	ˈləkka:	ˈla:ggɛ	ˈɟa:da:	ˈtò:pha:	ɟed (ə)
səˈda:	ˈbəssa:	ˈla:ga:	ká:d (ə)	ˈtəla:	kəˈlənna
səˈta:	ˈsədda:	ga:l (ə)	ˈgo:ḍḍa:	ˈpəta:	ɟedd (ə)
kəˈsa:	ˈləgga:	ˈgo:lli:	ɟa:t (ə)	ˈkəcca:	gətt (ə)
bəˈga:	ˈkəssa:	ləgg (ə,	ˈɟa:tta:	ˈkəca:	
dəˈba:	ˈbəga:	ˈgo:li:	da:kh (ə)	ˈbo:li	
kəˈḍà:	ˈdəbba:	ləg/ɟəg	dəkh (ə)	pʊll (ə)	
kəˈta:	ˈkəḍḍa:	ba:g (ə)	tʊˋkh (ə)	sət (ə)	
ɟeˈta:	ˈkətta:	ˈsəti:	ˈtò:kha:	ɟəgg (ə)	
dəˈkha:	ˈɟitta:	ˈbəgga:	khəˈba:r	ˈpətta:	
təˈkhà:	ˈpəˋkha:	ˈba:ggɛ:	tekkh (ə)	ˈbo:lli:	
cəˈtha:	ˈtʊkha;	ˈbəg (ə)	ˈkətha:	ɟəg (ə)	
ḍəˈpha:	ˈḍəppha:	ɟeˈda:i	ˈcɔ:tha:	ˈsətt (ə)	
bəˈtha:	ˈpəˋkkha:	ˈɟʊˋda:	cɔ:th (ə)	pʊl (ə)	
səˈkha:		dəbb (ə)	ˈkəttha:	ˈcəpəl (ə)	

List I was mainly intended for the analysis of consonants, vowel length, and stress.

List II consisted of the following words :

ˈkʊli:	ˈko: lli:	kʊl (ə)	ta:l (ə)
ˈgo:ḍḍa	gʊˈḍa:	kɔ:l (ə)	ti:l (ə)
ˈkʊlli:	ˈte:lla:	tɛ:ʃ (ə)	ku:l (ə)
ˈtɪlla:	ˈbo:bbo:	təl (ə)	tɪl (ə)
ˈkɪla:	ˈke:lla:	kʊl (ə)	ˈkɪlla:
ˈgʊḍḍa:	ˈkʊbbi:	te:l (ə)	

This was a supplementary list intended for a spectrographic analysis of vowel quality and of vowel length. A few words were taken from a third list, set up for a different purpose.

Vowel system, quantity and stress

2 2. The vowel phonemes of Dogri

Dogri has 10 oral and 5 nasal vowel phonemes, which can be set up in the following preliminary system :

i u		ĩ ʊ̃
ɪ ʊ		ɛ̃ ɔ̃
e ə o		ã
ɛ ɔ		
a		

For the oral vowels the following commutation series can be given tɪ:l(ə) 'match stick', te:l (ə) 'oil', tɪl (ə) 'sesam', tɛ:r (ə) 'to swim', təl (ə) 'to fry', ta:l (ə) 'to cleanse', tɔ:l (ə) 'to hurry', to:l (ə) 'to weigh', tʊl (ə) 'equal', tu:ṛ (ə) 'to fill'. The distinction between the nasal vowels can be shown by the words sərã: 'inn', sərĩ: 'name of tree', pərũ: 'last year', [pərẽ:⁓pərɛ̃:] 'away', [rõ: ⁓ rɔ̃:] 'wood', and the distinction between oral and nasal vowels can be shown by the pairs əkkhi; 'eye' vs. əkkhĩ: 'eyes', ku: 'say' vs. kʊ̃: 'warping of the cot', ɟa: gətɛ: 'the boy' (oblique form) vs. ɟa: gətɛ̃: 'the boys', sɔ: 'hundred' vs. sɔ̃: 'oath', ta: 'heat' vs. tã: 'then'. Bahri states that all ten oral vowels have nasal counterparts, but according to my own observations, there is free variation between [ẽ:] and [ɛ̃:] and between [õ:] and [ɔ̃:], and ɪ ʊ ə do

not show phonemic nasalization; when nasalized they are always followed by a nasal consonant, at least in the underlying form. In the case of the other vowels there is commutation between nasalized vowel and vowel plus nasal consonant (see later).

2.3. Acoustic analysis of vowel quality

A spectrographic analysis by means of the Kay Elemetric Sonagraph has been made of the ten oral vowels in the words ti: l (ə), tɪl (ə), te: l (ə), tɛ:ʃ (ə), təl (ə), ta: l (ə), kɔ: l (ə), ko: l (ə), kʊl (ə), ku: l (ə) spoken five times in the frame ʊs ... sʊn̥e:a: by the four informants RN, SD, SL, and VG. The reason for choosing k before rounded back vowels and t before front and unrounded open vowels was that these combinations give shorter formant transitions and thus facilitate the measurement of the vowel targets (but 'l' may have raised F_2 of the short vowel ʊ somewhat). Both wide band and narrow band sonagrams were made of all vowels, and in some dubious cases also sections.

For the unrounded vowels, the frequency of formants 1, 2 and 3 were measured, for the rounded back vowels only F_1 and F_2 could by measured since F_3 was (as it is normal for these vowels) too weak to be identified. Formants 1 and 2 of a: were sufficiently wide apart to be measured accurately for RN, SD and SL; but VG's vowels presented some difficulties in this respect. The exact location of F_1 in high vowels and the separation of F_1 and F_2 in u:, ʊ and o: presented the expected difficulties, and particularly F_2 in u: ʊ o: was dubious in many cases, so that the measurement of these formants must be taken with some reservation. SL's F_2 was very weak in these vowels. The high F_0 of VG's voice also presented difficulties for accurate measurements. The wide band sonagrams in most cases resulted in higher values than the narrow band spectrograms. The frequencies given are averages of the two measurements, except for the higher formants of front vowels which could be measured only on the wide band spectrograms.

The average formants of the ten vowels are given in table 1, and the frequencies of F_1 and F_2 of individual tokens have been plotted in figs. 1-4. A logarithmic frequeney scale has been used.

TABLE 1

Averages of vowel formant frequencies in mono-syllables for four subjects (N = 5).

		RN	SL	SD	VG
ti: l (ə)	F_1	285	291	286	266
	F_2	2255	2070	2285	2865
	F_3	3150	2538	3025	3287
tɪl (ə)	F_1	358	423	370	361
	F_2	2095	1785	2140	2520
	F_3	2580	2470	2590	2990
te: l (ə)	F_1	343	372	351	363
	F_2	2225	1975	2175	2635
	F_3	2920	2555	2720	3095
tɛ: ʃ (ə)	F_1	673	576	639	804
	F_2	1781	1454	1586	1851
	F_3	2450	2655	2705	2755
ta: l (ə)	F_1	684	597	780	860
	F_2	1096	1161	1135	1220
	F_3	2388	2625	2785	2666
təl (ə)	F_1	645	556	720	874
	F_2	1141	1188	1162	1544
	F_3	2562	2688	2725	2688
ku: l (ə)	F_1	279	346	314	321
	F_2	613	663	704	583
kʊl (ə)	F_1	364	392	336	350
	F_2	706	883	705	720
ko: l (ə)	F_1	348	395	352	377
	F_2	649	779	648	715
kɔ: l (ə)	F_1	579	499	539	588
	F_2	956	953	945	991

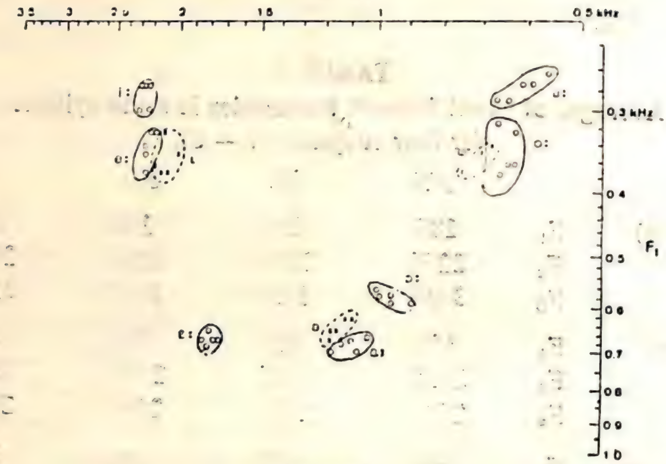


Figure 1
F_1/F_2 plot (logarithmic scale) of vowels in monosyllables. Subject RN.

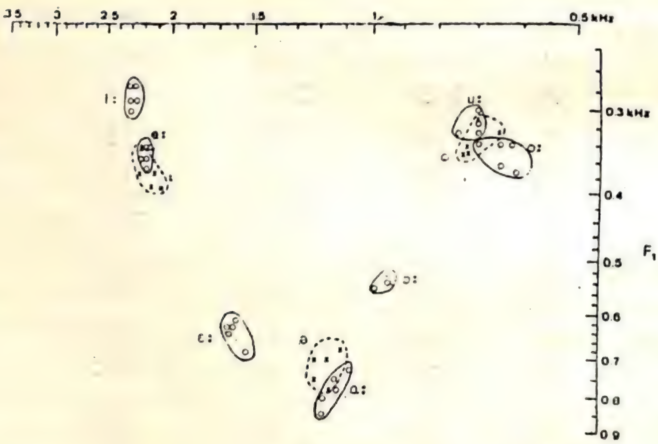


Figure 2
F_1/F_2 plot (logarithmic scale) of vowels in monosyllables. Subject SD.

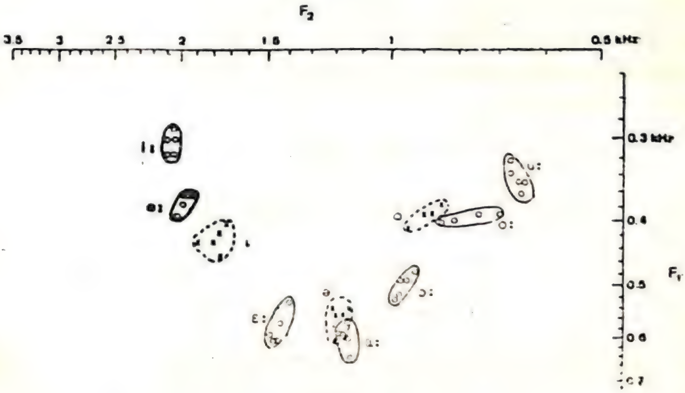


Figure 3

F_1/F_2 plot (logarithmic scale) of vowels in monosyllables.
Subject SL.

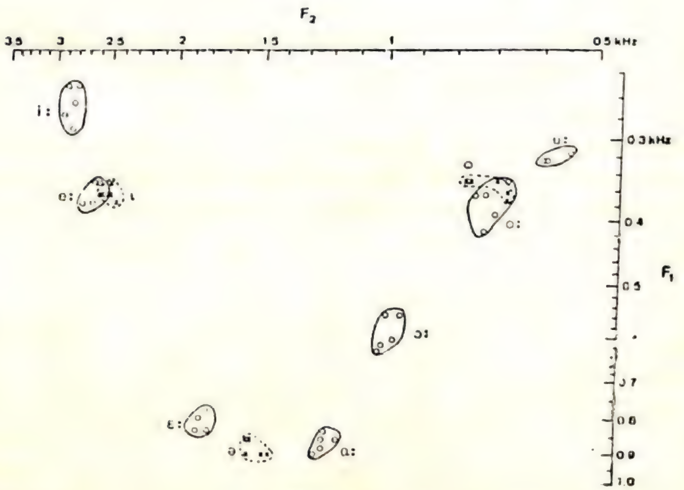


Figure 4

F_1/F_2 plot (logarithmic scale) of vowels in monosyllables.
Subject VG.

2.4. Distinctive features of the vowels

On the basis of the auditory impression and the acoustic analysis the following features were set up to distinguish the vowel phonemes of Dogri: ± high, ±back, ± round, ± long (or ±peripheral), and ±nasal. The distribution of the features is given in Table 2.

TABLE 2

Distinctive features of Dogri vowels

	i	e	ɛ	*a*	ɔ	o	u	ɪ	ə	ʊ	ĩ	ɛ	ã	ɔ̃	ũ
high	+	—	—	—	—	—	+	—	—	—	+	—	—	—	+
low	—	—	+	+	+	—	—	—	+	—	—	+	+	+	—
back	—	—	—	+	+	+	+	—	+	+	—	—	+	+	+
round	—	—	—	—	+	+	+	—	—	+	—	—	—	+	+
long	+	+	+	+	+	+	+	—	—	—	+	+	+	+	+
nasal	—	—	—	—	—	—	—	—	—	—	+	+	+	+	+

As for vowel height, I follow Chomsky and Halle (1968) in setting up two binary features, +high/—high and +low/—low. Ladefoged (1975) finds that the auditory property vowel height, as used in D. Jones' cardinal vowel quadrangle, is better correlated with the acoustic difference lower vs. higher first formant than with the articulatory feature "highest point of the tongue", whereas Mona Lindau (1977) has shown that the auditory impression correlates well with both the acoustic and the articulatory facts.

I have regarded *i*: and *u*: as +high, although *u*: comes rather close to ʊ and *o*: on the vowel charts. Auditorily it sounds higher, and for RN and SD it has a clearly weaker F_2 than *o*:, which may make the perceptual difference greater than shown by the frequencies of the formants on the chart. ɛ:, *ə*, *a*:, *ɔ*: are considered to be +low. The back low vowel *ɔ*: is not as low as the front low vowel ɛ: (which might also be transcribed [ae:]), but it is lower than *u*:, *o*:, and ʊ. It is separated from *a*: by the feature +round. *ə* is evidently a low

vowel in Dogri. It is heard by trained phoneticians as an [a]-sound [1]

As for ± back, I consider it also as binary. Here there is a clear correlation between the auditory impression and the front/back position of the tongue, and also with the acoustic differences in F_2. The more fronted the vowel, the higher F_2. Of Dogri vowels, I have regarded *i*: *e*: ɪ ɛ: as —back, and ə *a*: ɔ: ʊ *o*: *u*: as +back.

As for rounding, ʊ *u*: *o*: ɔ: are rounded. The others are unrounded. The only unrounded and rounded vowels of the same height and backness are *a*: and ɔ: .

The feature ± long is concomitant with the feature ± peripheral which is normally called tense/lax. I have regarded ± long as the distinctive feature and ±peripheral as a redundant feature which, however, helps a lot in the perception of the difference. On the whole, the short vowel ɪ ʊ ə are generally centralized to some extent in the F_1-F_2 vowels diagram, but the centralization is not as obvious as in the case of e.g. German lax vowels (Hans-Peter Jørgensen 1969). One informant only (SL) has clearly centralized ɪ and ʊ.

As regards ɪ and ʊ, they obviously have a higher F_1 (i.e. they are lower) than *i*: and *u*:, respectively: ɪ is much closer to to *e*: for all four informants, and in the case of SL even lower, and ʊ is closer to *o*: than to *u*: (perhaps with the exception of SD). As for the second formant, ɪ and ʊ are also more centralized than *i*: and *u*:. But they are not so clearly distinguished from *e*: and *o*:. Only SL, wno has evidently centralized ɪ and ʊ, has no overlapping between ɪ and *e*:, ʊ and *o*. RN has a slight overlapping between ʊ and *o*:, and VG and SL have extensive overlapping both for ɪ and *e*: and ʊ and *o*: (SD also for *u*: and ʊ), although the sounds were spoken in test words in the same surroundings (but VG has a stronger F_2 in *o*: than in ʊ.

1. Bahri uses the terms high-low. But he also talks of close-open (this seems to be a subdivision) and in some cases of compact-diffuse (the meaning of these latter terms is not clear. They are at any rate not used in the sense coined by Roman Jakobson (1952).

For one informant (SD), who has a particularly extensive overlapping, we tried to replace F_2 by F_2-F_1 (following Ladefoged 1975 and Mona Lindau 1977), but this did not improve matters. As *e*: has a higher F_3 than ɪ, we also tried for one informant to replace F_2 by a weighted averge of F_3 and F_2 according to Gunnar Fant's older formula (Fant 1959) but this gave only a very slight improvement. It must therefore be stated that, although there is a clear tendency to centralization for ɪ and ᴜ, there is some qualitative overlapping with *e*: and *o*:.

As for *ə*, it is more centralized than *a*:, vertically for SD and RN, horizontally for VG, and in both dimensions for SL, but both SL and SD show some overlapping.

Moreover, a test carried out with four trained Danish phoneticians listening to the first recording of list II, spoken by RN, SL, SD and CS, showed that they had obvious difficulties in identifying the centralized vowels, although all are familiar with German. kᴜl (ə) was heard as ko: l (ə) in all (3 × 4) cases (with one exception), təl (ə) as ta:l (ə) (one listener heard a mid [a-]), and tɪl (ə) as te:l (ə) in 8 out of 12 cases.

Thus the difference centralized-peripheral is not consistent and cannot be regarded as the only determining factor.

The difference of duration is, however, consistent. The so-called non-peripheral or lax vowels are always shorter than the corresponding peripheral or tense vowels in similar environments. In monosyllabic words, the duration of the long vowel is generally more than twice the duration of the short vowel, for SL slightly less than that (see toble 3[1]). The relative duration of vowels *i* ᴜ *ə* compared to *e*: *o*: *a*: lies between 35% and 42% for RN, SD and VG and at 54%—55% for SL. In disyllabic words, the vowels are shortened (table 4 shows this for some vowels) and still more so before geminated consonants, but the relations are maintained (see table 5), and SL has in this case the same relative difference as the other informants.

1. *VG's examples of [ku:l(ə)] were taken from a different recording where she spoke more slowly.*

TABLE 3

Average vowel duration in monosyllabic words in cs. (N=5)

	RN	SL	SD	VG
ti:l(ə)	24.5	16.6	34.5	26.4
te:l(ə)	25.5	15.6	35.6	27.1
tɛ:ʃ(ə)	25.4	18.8	35.8	27.8
t*a*:l(ə)	28.1	19.0	38.3	29.8
ku:l(ə)	23.9	17.6	35.0	(42.3)
ko:l(ə)	25.8	17.5	36.1	25.4
kɔ:l(ə)	25.4	17.1	36.8	25.8
tɪl(ə)	9.8	8.7	14.6	10.0
kʊl(ə)	10.6	9.5	14.2	8.9
təl(ə)	10.8	10.4	16.1	12.5
%tɪl(ə)/ti:l(ə)	39	52	42	38
kʊl(ə)/ku:l(ə)	44	54	41	(21)
təl(ə)/t*a*:l(ə)	38	55	42	42

TABLE 4

Average vowel duration in cs in some disyllabic words (N=5)

	RN	SL	SD	VG
ɟ*a*:d*a*:	14.0	12.8	18.2	18.8
bo:li:	11.6	12.5	20.0	16.6
kɪl*a*:	8.0	6.2	11.0	6.5
kʊli:	7.2	5.4	10.2	7.5

TABLE 5

Average vowel duration in disyllabic words before geminate consonants in cs (N=5)

	RN	SL	SD	VG
tɪll*a*:—te:ll*a*:	4.5—11.3	4.5— 9.1	6.0—14.0	4.0—10.0
kɪll*a*:—kell*a*:	4.3—10.6	4.3—10.0	5.4—14.5	3.5—11.0
kʊbbi:—bo:bbo:	5.6—11.4	4.3— 9.8	6.3—14.0	4.0—11.0
kʊlli:—ko:lli:	4.2—10.4	3.9—10.4	6.3—14.2	4.0—11.0
gʊḍḍ*a*—go:ḍḍ*a*:	4.8— 9.8	4.7—10.2	6.2—13.5	4.0—11.0
grand mean	4.7—10.7	4.3— 9.9	6.0—14.0	3.9—10.8
% short/long	44%	43%	43%	36%

The feature ± long used here corresponds to Bahri's central/peripheral[1]. He describes ɪ ɛ: *u*: as tense, ɪ *o*: as lax, but does not state anything about *a*: ɔ: ə ʊ regarding tenseness/ laxness, so it is not clear whether the term tense used by him corresponds to peripheral or not. According to my description, *o*: is + long and may be regarded as redundantly peripheral and tense, but not as lax.

Besides acoustic and auditory factors, there is another reason why I prefer the feature ± long. It appears that vowel quantity plays a role in the formation of rules for stress in Dogri. Stress in Dogri is predictable in some cases and unpredictable in others. All Dogri syllables can be placed in one of the following three grades: *Light* : a syllable ending in a short vowel ; *medium* : a syllable ending in a long vowel, or ending in a short vowel checked by a single consonant ; *heavy* : a syllable having a short vowel checked by two consonants, or a long vowel checked by one or two non-syllabic consonants.

Rule I : If there is one heavy syllable in the word, it is stressed. Two heavy syllables do not occur consecutively in Dogri in simple words. bəˈɟ*a*:r, kəˈpətt, ˈɟ*a*:ddi:, cəˈl*a*:kki:. Forms like *bəɟɟ*a*:r, *k*a*:pətt, *c*a*:l*a*:kki: cannot occur in Dogri.

Rule II : When there is more than one medium syllable (and no heavy syllable) in a word, the last but one of the medium syllables is stressed. ˈɟ*a*:ɖ*a*:, mərə ˈɟ*a*:d*a*, ˈbəgg*a*:, ˈɟ*a*:gət, bəˈɟ*a*:rɛ.

Rule III : When there is one medium syllable preceded by one or two light syllables, the stress is unpredictable and phonemic. ˈbəg*a*:, bəˈg*a*:, ˈpəgət*a*:, pəgəˈt*a*:, ˈrəso:, rəˈso.

The fact that in these rules each peripheral vowel (*i*: *e*: ɛ: *a*: ɔ: *o*: *u*:) behaves like one non-peripheral vowel (ɪ ʊ ə) + one

1. *He considers this difference as more stable than the difference of duration. In my 1970 paper I described the difference i:—ɪ and u:—ʊ as a length difference but ə—a: as a difference in vowel quality. But Bahri is certainly right in grouping* ɪ ʊ ə *together. As mentioned above, in this paper both quality and length are indicated (redundantly) in the transcription.*

non-syllabic, speaks in favour of the description of the former as long and the latter as short. Thus, both phonetic and phonological arguments speak for considering length and not centralization as the relevant feature.

As regards the relationship of short vowels to long vowels, they are grouped traditionally as ɪ *i*: ʊ *u*:, ə *a*:. The are, no doubt, related historically, but now, by being lowered and centralized, ɪ ʊ have come phonetically closer to *e*: *o*: than to *i*: *u*:

Moreover, there are various related words in Dogri in which there is morphological alternation of long vowels with short vowels. Here the long,—low,—high vowels (*e*:*o*:) alternate with short—low,—high vowels (ɪ ʊ), while the +low long vowel (*a*:) alternates with the + low short vowel (ə).

Long vowel in transitive verb		*Short vowel in intransitive verb*	
ḍo:b(ə)	'to dip'	ḍʊb(ə)	'to dive'
kho:l(ə)	'to open'	khʊl(ə)	'to be opened'
ke:r(ə)	'to fell'	kɪr(ə)	'to fall'
ré:ṛ(ə)	'to push'	rɪ'ṛ(ə)	'to crawl'
p*a*:l(ə)	'to bring up'	pəl(ə)	'to be brought up'
g*a*:l(ə)	'to cause to melt'	gəl(e)	'to melt'

Long vowel in noun		*Short vowel in verb*	
ḍo:bb*a*:	'a dip'	ḍʊbb*a*	'past of verb ḍʊb to dive'
co:r(ə)	'a thief'	cʊr(ə)	'to be stolen'
d*a*:l(ə)	'grinded beans'	dəl(ə)	'to grind'
bá:dd*a*:	'an increase'	bə'd(ə)	'to increase'
so:kk*a*:	'drought'	sʊk(ə)	'to get dry'

So it seems more reasonable to group ɪ-*e*: and ʊ-*o*: together by regarding them as —low and —high, and to group ə with *a*: and regard both of them as + low.

2.5 Distribution

On the basis of their behaviour in the syllable structure of

the language, long and short vowels also form two distinct groups. The short vowels, viz. ɪ ʊ ə occur initially and medially but do not occur finally, where they may be considered to be neutralized with i: (e:), u: (o:) and zero, respectively. There are a few functional words in which they appear finally, e.g. kɪ 'that', jɪ 'that', kʊ 'about', cə 'in', ʃə 'from', but these words are short forms of ke: je:, bɪɛ, kəʃ and are pronounced frequently in full form. ə appears phonetically as a vocalic release in some cases, especially after geminated consonant or consonant clusters in final position, but it is not phonemic in this position and often alternates with zero. The other short vowels ɪ ʊ do not occur in this position. Long vowels, *i*: *e*: ɛ: *a*: ɔ: *o*: *u*:, occur initially, medially, and finally, but they do not occur in the first syllable of simple disyllabics with closed final syllable which have a vowel of the same group in the second syllable, nor in trisyllabic words with a long vowel in the second syllable.

Dogri short and long vowels occur in the following syllabic patterns:

(C)V	+	only in a few functional words (ci, ʃə, etc.)
(C)V:	+	*a*: 'come', b*a*: 'breeze'.
(C)VC	+	məl(ə) 'paste', mɪl(ə) 'meet', pʊl(ə) 'bridge'.
(C)V:C	+	mi:l(ə) 'mile', me:l(ə) 'union', mɛ:l(e) 'dirt', m*a*:l(ə) 'herd of animals', tɔ:l(ə) 'hurry', to:l(ə) 'weight', mu:l(e) 'beginning'.
(C)VCC	+	gəlt(ə) 'wrong', pʊll(ə) 'softness'.
(C)V:CC	+	à:lt(ə) 'condition'
CVCV	—	
(C)VCV:	+	pət*a*: 'address', pʊj*a*: 'blessing'.
CV:CV	—	
(C)V:CV:	+	ˈp*a*:l*a*: 'cold'.
(C)VCVC	+	ˈkədər(ə) 'respect'.
(C)VCV:C	+	bəˈz*a*:r(ə) 'market'.
(C)V:CVC	+	ˈɟ*a*:gət(ə) 'boy'.

CV:CV:C	—	
CVCCV	—	
(C)VCCV:	+	ˈbəgg*a*: 'whitish', ˈpuɟɟ*a*: 'arrived'.
CV:CCV	—	
(C)V:CCV:	+	ˈbo:lli: 'speech', go:ḍḍ*a*: 'knee'. ke:ll*a*
(C)VCCVC	+	ˈkheɟɟəl 'distressed'.
(C)VCCV:C	+	mərˈɟ*a*:d 'propriety of conduct'.
(C)V:CCVC	+	ˈ*a*:lsən(ə) 'lazy woman', *a*:kkhən 'saying'
CV:CCV:C	—	
CVCVCV:	+	ˈcəkəl*a*: 'bread-board'.
CVCVCCV:	+	cəˈkənn*a* 'watchful'.

This distributional description is at variance with Bahri's assertion that peripheral vowels do not appear before geminates. However, as shown in table 5 the difference of duration is preserved before geminates, and even if all informants are taken together, there is no overlapping at all between single tokens of the two vowel categories (see fig. 5); exactly the same picture was found for the word pairs dəbb*a*:/d*a*:bb*a*:, sutt*a*:/so:tt*a*:, gutt*a*:/go:tt*a*:, ḍubb*a*:/ḍo:bb*a*:. Thus, when length is taken to be the distinctive feature, it must be stated that long and short vowels are kept clearly apart before geminates.

As for the difference in quality, the vowels are not confounded more often than in monosyllabics. The word pairs kulli:/ko:lli:, guḍḍ*a*:/go:ḍḍ*a*:, kubbi:/bo:bbo:, tɪll*a*:/te:ll*a*:, kɪlla:/ke:ll*a*:, and bəgg*a*:/b*a*:ggɛ: were measured for the informants RN, SL, SD and VG. As far as the words with u and *o*: are concerned, SL and RN have slightly more overlapping than in the monosyllabic words, VG approximately the same, but she has always a stronger F_2 in *o*: than in u. SD has no overlapping (in contradistinction to his monosyllabic words); the members of all three pairs are kept apart by means of F_2, but the relation of F_2 in *o*: and u has been reversed in the pair kubbi:/bo:bbo: in which *o*: has a higher F_2 than u.

The words with *e*: and ɪ are kept apart by means of F_2 by all informants (for SD and VG there is overlapping in the monosyllabic words) F_2 of kɪll*a*: is somewhat uncertain but lower than in ke:ll*a*:. The formant averages of tɪll*a*:/te:ll*a*: are given in table 6 together with the formant averages of the pair

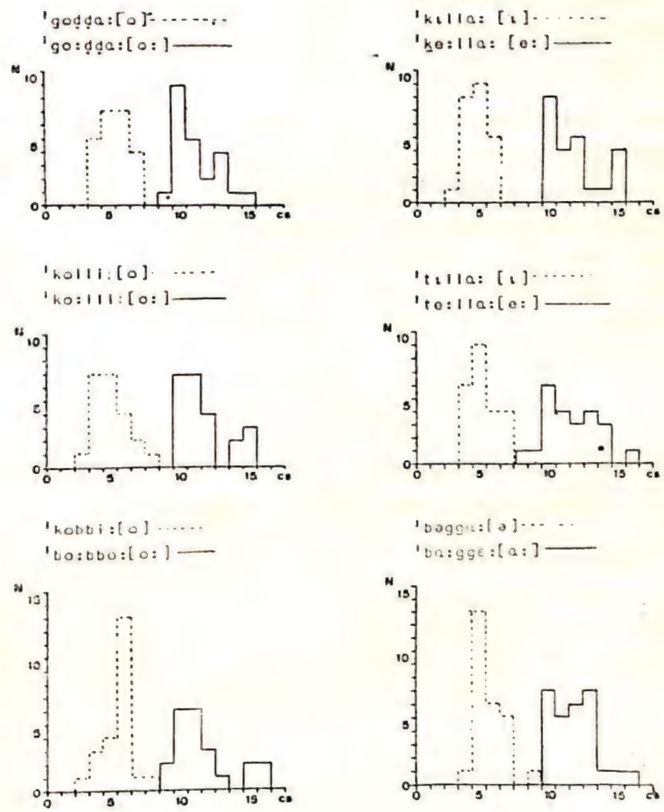


Figure 5

Duration of central (... ..) and peripheral (———) vowels before geminated consonants. Five informants (N=23) combined (for ˈbəgg*a*:/b*a*:ggɛ: six informants) (N=28—26).

bᵊgg*a*:/b*a*ggɛ:. This latter pair is kept more clearly apart than tᵊl (ᵊ)/t*a*:l(ə), but ᵊ in ˈbᵊgg*a*: is shifted upwards in the vowel chart, i.e. it has a much lower F_1 and a somewhat lower F_2 than in tᵊl(ə). The shift in F_2 is due to the place of articulation of the surrounding consonants: in tᵊl(ə) the two dentals have a raised F_2, whereas *b* in bᵊgg*a*: lowers F_2. As for F_1, the main reason is that ᵊ is much shorter in bᵊgg*a*:, and in position between two stops it becomes less open. This lax vowel is very much influenced by the surroundings, particularly when it is shortened. The placement of ə in the charts figs. 1-4 must therefore be taken with some reservation.

In any case, the two types of vowels are kept clearly apart as far as length is concerned, and at least as much as in monosyllabics as far as quality is concerned. Now it is possible that Bahri would not deny that the words mentioned above have peripheral vowels (although he speaks of neutralization before geminates), but that he considers the following consonant not as geminate, but as fortis. For a further treatment of this problem, see section 4.

TABLE 6

Average formant frequencies in Hz of the first vowels in ˈtɪll*a*:, ˈte:ll*a*:, and ˈbᵊgg*a*:, b*a*:ggɛ: (N=5)

		RN	SL	SD	VG
ˈtɪll*a*:	F_1	381	373	345	385
	F_2	1914	1615	1995	2250
	F_3	2560	2515	2570	2917
ˈte:ll*a*:	F_1	353	381	349	422
	F_2	2195	1910	2188	2383
	F_3	2750	2580	2713	2942
ˈbᵊgg*a*:	F_1	540	506	546	686
	F_2	1017	1073	1055	1260
b*a*:ggɛ:	F_1	698	678	711	892
	F_2	1100	1120	1190	1365

2.6 Phonological interpretation of the contrastive types ˈgəla:- gəˈla:

2.6.1 *The problem*

In section 2.4 it was stated that there is a consistent length difference between peripheral and centralized vowels and that this difference is more stable than the difference of quality. There is, however, also a difference of duration *within* the group of peripheral vowels in open final position, and there is quite a number of minimal pairs, e.g. (in narrow phonetic transcription) :

	A		B
ˈdəri:	'carpet'	d(ə)ˈri:	'daughter of husband's younger brother'
ˈpərəti:	'filling of earth'	p(ə)rəˈti:	'brother's daughter'
ˈtəl*a*:	'sole of shoe'	t(ə)ˈl*a*:	'water pond'
ˈgəl*a*:	'throat'	g(ə)ˈl*a*:	'to say'
ˈbəg*a*:	'to flow'	b(ə)ˈg*a*:	'cause to flow'
ˈpər*a*:	'to fill'	p(ə)ˈr*a*:	'cause to fill'
ˈpəl*a*:	'to be brought up'	p(ə)ˈl*a*:	'to make one drink'
		r(ə)ˈso:	'kitchen'
ˈrəso:	'live (imp. v.)		

Besides the difference of vowel length in the second syllable, there is also a difference of stress. Whereas the first syllable is stressed in the words in column A, the second syllable is stressed in the words in column B. Moreover, [ə] of the first syllable is shorter and may be optional in column B, but not in A.

The problem is how to explain these forms phonologically. It is possible to set up four different solutions.

(1) The first vowels (ə) may be regarded as long in words in column A and as short in words in column B. It means setting up a short-long opposition in a central vowel or splitting *ə* into two phonemes, one in the group of central vowels and another in the group of peripheral vowels.

(2) The first vowel (ə) may be regarded as being present

in words in column A, and as being absent in words in column B. This means that ə in words of column B is considered as a non-phonological svarabhakti vowel which may be inserted to avoid heavy consonant clusters in the surface form. Then there will be no need to set up a short/long opposition in peripheral vowels.

(3) The second vowels (*a*: *i*: *o*:) may be regarded as normal long vowels in words in column A and as over-long /*a*:ˑ i:ˑ o:ˑ/ in words in column B. Thus, central vowels will always be short, but there will be an opposition between longer and shorter peripheral vowels in final, open syllables.

(4) The difference of stress may be regarded as phonemic. Thus, stress is on the first syllable in words in column A and on the second syllable in words in column B.

2.6.2 *The solutions* 1 *and* 2 (ə)

Solution 1 is rather impracticable on the following grounds: Firstly, the difference of duration in the two types of ə is small, generally 2-3 centiseconds, i.e. much smaller than the normal minimal difference between long and short vowels (cf. tables 3-5) Phonetically, ə is always short and in this respect behaves like ɪ and ʊ. Moreover, a length difference in ə would be in contradiction to the general concomitance of length and quality. ə is certainly not peripheral phonetically, and phonologically it evidently behaves as a central vowel. The syllabic structure of Dogri does not tolerate two peripheral vowels in a disyllabic word with closed second syllable. As ə appears in such words with a peripheral vowel, it must be regarded as non-peripheral. Words like **ba:da:m*, **ja:ga:t* cannot occur in Dogri, but bəd*a*:m and j*a*:gᵊt do occur.

Moreover, there are various related words in Dogri in which a morphological alternation of peripheral vowels with non-peripheral vowels occurs. The vowel ə appears as a non-peripheral vowel in such alternations (see 2.4).

Solution (2) is also faced with difficulties.

First of all, the deletion of ə in the phonological form of words in column B will lead to the occurrence of a large number

of strange consonant clusters which do not otherwise occur in Dogri.

Initial clusters in Dogri consist of stop + *r*. *ṛ* or *l*. Final clusters in Dogri consist of (1) flap or lateral + stop, or sibilant or nasal, (2) sibilant + stop or nasal, (3) nasal + stop.

Deletion of *ə* will give rise to such initial clusters as

Voiced stop+voiced stop	bəga:	→	bga:
Unvoiced stop+unvoiced stop	tapa:	→	tpa:
Voiced stop+unvoiced stop	gəta:r(ə)	→	gta:r(ə)
Unvoiced stop+voiced stop	təbela:	→	tbela:
Aspirated stop+unaspirated stop	khəta:i:	→	khta:i:
Unaspirated stop+aspirated stop	təkha:	→	tkha:
Stop+lateral	təla:	→	tla:
Lateral+stop	ləta:ṛ(ə)	→	lta:ṛ(ə)
Sibilant+stop	səka:	→	ska:
Stop+sibilant	kəsa:	→	ksa:

Moreover, there seems to be a phonological distinction between stop consonant + *r*, and stop consonant + *ə* + *r* in a few cases, e.g. təra: 'cause to swim' and tra: 'fear'.

Secondly, *ə* occurs in free variation with ɪ *a*: in a restricted number of words, but not in others.

ˈphɪra:	past form of verb 'to walk about'	phɪˈra:‿phəˈra: 'to make one move about'
ˈpuɟɟa:	past form of 'to reach'	puˈɟa:‿pəˈɟa: 'to make one reach'
ˈlɪkha:	past form of 'to write'	lɪˈkha:‿ləˈkha: 'to make one write'
ˈtukha:	past form of 'to smoke'	tuˈkha:‿təˈkha: 'to make a thing smoke'

If /ə/ is regarded as absent in words in column B, it cannot be explained how some words may also insert ɪ or u in consonant clusters. ɪ and u cannot be determined by the surroundings.

Thus, neither the interpretation of ə in /'gəla:/ as long, nor the interpretation of ə in /gə'la:/ as non-phonemic can be considered to give a satisfactory solution of the problem.

2.6.3 Solutions 3 and 4 (stress or quantity)

Solutions (3) and (4) are both plausible. The problem is that stress and vowel length co-occur, and it is difficult to decide which is the independent variable.

An argument against choosing stress as the relevant property is that stress is in most cases predictable (see 2.4). The only word types where it is not predictable are those under discussion here, i.e. disyllabic words with a light + a medium syllable (dəri :) or trisyllabic words with two light syllables +a medium syllable (pəgəta:). Moreover, non-Dogri speakers, also trained phoneticians, tend to hear the difference as one of length only, perceiving the second syllable as stressed in both types. A test with disyllabic Dogri words of different types has been carried out by Eli Fischer-Jørgensen. It consisted of 26 words said five times each by VG in a frame with non-final intonation, and 16 of the same words said three times as the last words in a frame with final intonation. The listeners were Danish phoneticians and students of phonetics, 14 in the first case and 8 in the second. The result was that, when said with non-final intonation, the words 'pəla:, 'dəri:, 'kéṛa:, 'kə'ri:, 'k`əri:, 'pə`ra: showed a great majority (90%) for stress on the second syllable, whereas with final intonation the words with high tone ('kə'ri: and 'kə'ṛa:) were heard as stressed on the first syllable (90%). 'pəla: had a small majority for first syllable stress (58%), but 'pə`ra: with falling tone was still heard as stressed on the second syllable (92%). Eli Fischer-Jørgensen, who listened to the recordings of all informants, also heard the type 'CəCa: as stressed on the second syllable in all cases. But this, of course, does not prove that, from the point of view of Dogri structure, the stress is not on the first syllable. The reaction of the listeners may be due to the fact that they were not accustomed to hearing the type: stressed syllable with short ə + unstressed syllable with longer full vowel and often rising pitch, which is a very rare type, at least in European languages. (With final intonation, the

second vowel was shortened so that the difference of length was small, and it was also somewhat lower in frequency.)

An argument against choosing length is that we would thus get three degrees of length in vowels. This is not a very strong argument, though, since there would only be two degrees in each position: long and overlong in open final syllable, short and long elsewhere, but it is, at any rate, not possible to identify the final vowels in words like ˈdəri: and ˈpəl*a*: ˈrəso: with short centralized vowels.

The strongest arguments, however, come from two facts of Dogri phonological structure, which point to stress as an indispensable part of the phonological system: (a) stress determines the place of the word tone, (b) it must be taken into account in the rules for nasalization. The present writer has therefore chosen stress as the distinctive difference of the two word types.[1]

(a) *Tone and stress*: Dogri has tonal distinctions and there is mutual interaction between stress and tone. Dogri has three phonologically distinct tones.

I. Neutral tone, which is unmarked, often slowly rising.

II. Falling tone, which starts at a point generally higher than the middle of the voice range of the speaker and then falls to the lowest point, from where it generally rises somewhat again.

III. Rising tone, which starts at a point generally lower than the middle of the voice range and then rises to the highest level or at least to a level higher than the middle of the voice range (it may fall somewhat again at the end).

I.	r*a*:	'opinion'	I.	k*a*:r	'work'
II.	rà:	'tune'	II.	kà:r	'house'
III.	rá:	'way'	III.	ká:r	'line'

1. *Bahri does not treat this problem, but he puts a stress mark in words of the type dəˈri: (with even tone), which indicates that he is of the same opinion.*

These are word tones in the sense that only one significant tone occurs on a simple word. They can, however, be described as syllabic tones in the sense that the start of the tone may occur on any one of the syllables in a polysyllabic word, while other syllables are adjusted to the starting point and the end point of the tonebearing syllable. The position of tone is thus distinctive and which syllable of the word will carry the tone is determined by stress. Thus all words which are placed in column A have the start of the tone on the first syllable peak, and words in column B on the second syllable peak. This difference is more clearly perceived in the case of falling and rising tones:

	A		B
ˈpəˋṛ*a*:	'read'	pəˈṛà:	'teach'
ˈkəʹṛ*a*:	'boil'	kəˈṛá:	'frying pan'

Historically, the tones in Dogri are connected with aspiration and stress accent of classical Sanskrit (OIA) and Prakrits (MIA). If the aspiration (generally voiced) followed a stressed vowel, it gave rise to a rising tone, and if it preceded a stressed syllable, it gave rise to a falling tone. This phenomenon is seen even now in new loanwords which Dogri has borrowed from Hindi or Urdu. The following two words of Hindi are realized with two different tones in Dogri, due to their difference of stress:

Hindi			*Dogri*
svəˈbh*a*v	'nature'	→	sʊbà:
ˈsəbh*a*	'meeting'	→	səʹb*a*:

The Urdu word ˈsubəh 'morning' is realized as sʊʹb*a*: in Dogri. Tone alternations in such word pairs as ləʹb*a*/ləbà, kəʹḍ*a*:/kəḍà:, pəʹṛ*a*:/ pəṛà: are easily explained by stress, which preceded aspiration (historically) in one case and followed it in another. From a synchronic point of view, it can be stated that stress is significant in all these cases and is realized phonetically by duration and pitch movement.

It might be possible to set up underlying forms with aspiration in all such words where low or high tone appears in surface

forms and derive the surface forms by means of the following rules:

1. The aspirate *h* occurring as an independent consonant or as part of a voiced aspirated consonant disappears when followed by a stressed vowel in the sam: syllable or any following syllable, giving rise to low tone on that syllable.

<table>
<tr><td>| ˈha:r | [1]</td><td>à:r</td><td>‘garland’</td></tr>
<tr><td>| bəˈha:r |</td><td>bà:r</td><td>‘season’</td></tr>
<tr><td>| gəˈha:r |</td><td>gà:r</td><td>‘a village given in donation’</td></tr>
<tr><td>| səməˈɟha: |</td><td>səməɟà:</td><td>‘to make one understand’</td></tr>
<tr><td>| ləˈbha: |</td><td>ləbà:</td><td>‘to cause to find out’</td></tr>
<tr><td>| pəˈṛha: |</td><td>pəṛà:</td><td>‘to teach’</td></tr>
<tr><td>| bəˈdha:ṇa: |</td><td>bədà:ṇa:</td><td>‘to cause to increase’</td></tr>
</table>

2. If a voiced aspirate is not preceded by a vowel, the voiced stop also loses its voice.

<table>
<tr><td>| ˈgha:r |</td><td>kà:r</td><td>‘house’</td></tr>
<tr><td>| ˈbha:r |</td><td>pà:r</td><td>‘weight’</td></tr>
<tr><td>| ˈbhra: |</td><td>prà:</td><td>‘brother’</td></tr>
</table>

3. The aspirate *h*, occurring as an independent consonant or as part of a voiced aspirated consonant, disappears when a stressed vowel precedes it in the same syllable or any preceding syllable, giving rise to a high tone on that syllable.

<table>
<tr><td>| ˈka:hr |</td><td>ká:r</td><td>‘line’</td></tr>
<tr><td>| ˈba:hr |</td><td>bá:r</td><td>‘outside’</td></tr>
<tr><td>| ˈla:bh |</td><td>lá:b</td><td>‘profit’</td></tr>
<tr><td>| ˈləbbha: |</td><td>ləˈbba:</td><td>‘found out’</td></tr>
<tr><td>| ˈsəməɟha: |</td><td>səˈməɟa:</td><td>‘understanding’</td></tr>
<tr><td>| ˈpəṛha: |</td><td>pəˈṛa:</td><td>‘to study’</td></tr>
<tr><td>| ˈlo:ha: |</td><td>lóa:</td><td>‘iron’</td></tr>
<tr><td>| ˈla:h |</td><td>lá</td><td>‘use’</td></tr>
</table>

1. Vertical lines are used to indicate underlying forms.

But even if these historically induced underlying forms are not set up, stress must be considered phonemic in Dogri since the place of tone is distinctive.

(*b*) *Nasalization and stress*: The phenomenon of nasalization in Dogri is also related to stress. Nasalization is phonemic in final open syllables but is predictable and non-phonemic in other cases.

/b*a*:/	'wind'	/bã:/	'water reservoir'
/j*a*:/	'go' (2nd person)	/jã:/	'go' (1st person)
/t*a*:/	'heat'	/tã:/	'then'
/ku:/	'speak'	/kũ:/	'I should speak'
/mᵊˈn*a*:/	'console' (imp.)	/mᵊˈnã-/	'I should console'
/kᵊˈm*a*:/	'earn'	/kᵊˈmã:/	'I should earn'

But nasalization is predictable in other positions. A stressed vowel followed by a nasal consonant belonging to the same syllable or the following syllable is allophonically nasalized, and if it is followed by an unstressed vowel, that vowel too is nasalized.

[ˈjã:n]	/j*a*:n/	'life'
[ˈjã:*n*]	/j*a*:*n*/	'(I) will go'
[ˈmə̃nã:]	/ˈmᵊn*a*:/	'refuse'
[ˈj mã:]	/ˈjᵊm*a*:/	'addition'
[ˈdũ:ṇ*a*:]	/ˈdu:ṇ*a*:/	'double'

But this allophonic nasalization does not occur in a stressed vowel following a nasal consonant.

[dᵊˈm*a*:k(ə)]	'brain'
[tᵊˈmo:l(ə)]	'money given at the marriage ceremony'
[sᵊnɛ′:r(ə)]	'brightness'

Moreover, a cluster consisting of a homorganic nasal plus a consonant tends to be simplified word-finally and when preceded by an unstressed vowel and followed by a stressed vowel (the preceding vowel is always nasalized). In the cluster of a homorganic nasal with a velar and a palatal stop, the velar nasal and

the palatal nasal are preserved, while the stop is lost (a); in other cases the nasal consonant disappears, while the other consonant is preserved (b).

(a)	/ˈḍi:ṅg/	[ˈdĩ:ṅ]	'boasting'
	/səñɟ/	[ˈsə̃ñ]	'evening'
	/rəṅga:i/	[rə̃ˈṅa:i]	'dyeing'
(b)	/gənḍà:i/	[gə̃ḍà:i]	'repairing'

But the cluster is not simplified when a stressed vowel precedes it as in ˈgənḍa:, ˈgənda:, ˈba:ndər.

Thus, both non-phonemic nasalization and simplification of clusters with nasals are determined by stress.

As mentioned above, the place of tone is also determined by stress, and these two factors together form, in my opinion, a strong argument for regarding stress as part of the phonological system of Dogri.

2.7. Phonetic analysis of the problematic word types

2.7.1. *Duration*

A phonetic analysis of syllable duration in types A (ˈgəla:) and B (gəˈla:) supports the interpretation of the difference as one of stress.

Ten words from list I could be compared pairwise in this respect, viz. ˈgəla:/gəˈla:, ˈpəla:/pəˈla:, ˈbəga:/bəˈga:, ˈpəkha:/pəˈkha:, and ˈpəta:/kəˈta:. These words were spoken five times each by the informants RN, SL, SD, CS and VG, and three times each by AS (AS did not read the pair ˈpəta:/kəˈta:) Moreover, the following words, spoken five times by VG (in the test list) could be compared pairwise: ˈpə̀rà:/pəˈra: and ˈkəˈṛa:/kəˈṛá:.

All segments of these words have been measured in centiseconds on the basis of mingogram recordings comprising a duplex oscillogram, two intensity curves, highpass filtered at 500 and 2000Hz, a high fidelity intensity curve, and a pitch curve. Since the words were spoken in the frame us (ə)...suṇe:a: the initial consonant could also generally be delimitated. It gave,

however, some problems that the speakers sometimes made a short pause after the word US (ə) of the frame, which could not be distinguished from a voiceless closure. For initial stops the measurement of the initial consonant is therefore somewhat uncertain. But the delimitation of vowels and medial consonants did not generally present any serious problems. The start of the medial consonant was taken to be at the point where the oscillations of the duplex oscillogram are diminished abruptly, where the intensity curve, correspondingly, decreases abruptly, and where the pitch curve drops out or decreases abruptly. This point also corresponds to the cessation of the vowel formants on the spectrograms. The closure of stops is reckoned from this point to the explosion, and the aspiration (or, for unaspirated stops, "the open interval") is reckoned from the explosion to the steep rise of the intensity curve for the next vowel.

Averages were taken of the five recordings for each informant and differences between the averages of the word pairs calculated. Table 7 contains the average durations of the segments of each word for all informants combined and the differences between the corresponding averages for each word pair.

The significance of the overall averages can be judged by looking at the separate averages. For each segment of a given position (e.g. the first consonant in type A words), there are 31 averages viz. 6 informants x 5 words (minus one for AS, plus two for VG), which can be compared with the corresponding 31 averages for word type B.

The main difference obviously lies in the second vowel. It is longer in type B words than in type A words, the average difference for all words being 8.7 cs. This difference is evidently significant. It is valid in 30 out of 31 pairs of averages (CS, who has spoken very quickly and shortened the final vowels, so that she has an average difference of only 2.5 cs, has one average without any difference, but even she has no overlapping in single tokens with the exception of the word pair ˈpəkh*a*:/təˈkh*a*:).

The preceding consonant of the second syllable is also

TABLE 7

Average durations (in cs) of segments and syllables of word types A and B for all informants combined.

		N	cons.	vowel	1. syll.	cons.	vowel	2. syll.
A	ˈgəl*a*:	23	10.2	6.6	16.8	4.9	11.3	16.2
B	gəˈl*a*:	23	10.6	4.5	15.1	6.0	19.4	25.4
	diff. A-B		—0.4	+2.1	+1.7	—1.1	—8.1	—9.2
A	ˈpəl*a*:	23	13.1	6.2	19.3	4.7	11.9	16.6
B	pəˈl*a*:	23	12.2	3.4	15.6	6.2	18.5	24.7
	diff. A-B		+0.9	+2.8	+3.7	—1.5	—6.6	—8.1
A	ˈbəg*a*:	23	11.3	7.9	19.2	4.4	12.3	16.7
B	bəˈg*a*:	23	10.7	6.2	16.9	5.5	20.4	25.9
	diff. A-B		+0.4	+1.7	+2.1	—1.1	—8.1	—9.2
A	ˈpəkh*a*:	23	13.0	6.2	19.2	9.3	12.2	21.5
B	təˈkh*a*:	23	11.8	4.9	16.7	10.1	19.5	29.6
	diff. A-B		+1.2	+1.3	+2.5	—0.9	—7.1	—8.1

(continued)

(Table 7 continued)

A	ˈpəta:	20	14.8	7.0	21.8	6.7	14.5	21.2
B	kəˈta:	20	11.7	3.8	15.5	7.5	20.8	28.3
	diff. A-B		+3.1	+3.2	+6.3	−0.8	−6.3	−7.1
VG only								
A	ˈpəˋra:	5	12.5	9.8	22.3	2.0	17.7	19.7
B	pəˈrà:	5	12.3	7.0	19.3	2.0	34.2	36.2
	diff. A-B		+0.2	+2.8	+3.0	0	−16.5	−16.5
A	ˈkəˈṛa:	5	14.2	9.2	21.4	2.0	17.7	19.7
B	kəˈṛá:	5	13.2	7.6	20.8	2.2	27.0	29.2
	diff. A-B		+1.0	+1.6	+2.6	−0.2	−9.3	−9.5
Difference A-B between all words combined.			+1.0	+2.2	+3.2	−0.8	−8.9	−9.7

slightly longer in type B than in type A words. This difference is small, 0.8 cs on the average, but it is stable and is valid for 26 out of 31 pairs of averages (in two pairs there is no difference, and in three cases the relation is inverted). This means that it is not only a question of the duration of the second vowel but one of syllable length, which indicates that it is a manifestation of stress. (The difference in the total length of the second syllable in type A and type B words is 9.7 cs.)

This is supported by the relations between the first syllables. Here the vowel is also longer when stressed, i.e., it is longer in type A than in type B words. But the difference is considerably smaller than in the second syllable (2.2 cs. on the average), which may be explained by the fact that the vowel is short and cannot be lengthened so much. There is generally a much larger scatter of the values in long vowels than in short vowels. In a quantity opposition, the short member may be considered as a point, whereas the long member is stretchable (Lehiste 1979, p. 36). The small difference is, however, very stable. It is valid in 28 out of 31 pairs of averages and evidently significant. (It was mentioned in 2.6 that the vowel may disappear completely in type B words. In the present material this has, however, happened in only four single tokens, spoken by VG.)

As for the initial consonant of the first syllable, the difference is not stable. It is longer in type A than in type B words in 21 out of 30 pairs of averages but, as mentioned above, the delimitation has not always been quite certain. The difference adds, however, to the difference of the syllables, the first syllable being longer in type A words than in type B words in 27 out of 30 pairs of averages (in one case the first consonant has not been measured because of a long pause).

Type A (ˈgəl*a*:) is not a very common word type in Dogri. When the first syllable is stressed, the following consonant is often geminated. There are thus more pairs like ˈbəgg*a*:/bəˈg*a*: (the type ˈbəgg*a*: will be called type C in the following). The duration of the second vowel in 12 such pairs has been measured for the subjects RN, SL, SD, CS and VG.

The difference between the final vowels in type C (e.g.

ˈbəgga:) and B (e.g. bəˈga:), viz. 9.0 cs (all subjects combined), is practically the same as the difference found between type A (e.g. ˈbəga:) and type B, viz. 8.9 cs.

As for the vowel of the first syllable, there is hardly any difference between B and C. This is, however, due to the fact (mentioned in 2.4) that vowels are shortened before geminated consonants. This appears very clearly from a comparison between triplets such as ˈbəga: (A), bəˈga: (B), ˈbəgga: (C). There are four such comparable triplets in the material, viz.

A	B	C
ˈbəga:	bəˈga:	ˈbəgga:
ˈpəˋkha:	təˈkhà:	ˈpəkkha:
ˈpəta:	kəˈta:	ˈkətta:
ˈkətha:	cəˈtha:	ˈkəttha:

The duration of the first vowel was measured for the subjects RN, SL, SD, CS and VG.

For all subjects combined, the difference between A and B is 2.1 cs, and the difference between A and C is 2.2 cs. This means that on the average the vowel is shortened to the same degree when unstressed and when followed by a geminated consonant, and the reason why ə in C (ˈbəgga:) is not shortened compared to B (bəˈga:) (the difference is 0.1 cs only), although it is followed by a geminated consonant, is that it is stressed. Stress has thus the same influence here as in the preceding cases.

Other examples in the material, where only A and C or B and C can be compared, support this result. The difference in duration between the first vowels in A and C (i.e vowels in stressed syllables before single or geminated consonants) is on the average 2.7 cs for the pairs ˈkəca:/ˈkəcca:, ˈkʊli:/ˈkʊlli: and ˈkɪla:/ˈkɪlla:, and almost the same (2.7 cs) before final geminate (sət (ə)/sətt (ə), ɟəd (ə)/ɟədd (ə), pʊl(ə)/pʊll(ə), ɟəg(ə)/ɟəgg(ə), gəɟ(ə)/gəɟɟ(ə)]. In the case of two long vowels, it is slightly larger, viz, 3.6 cs for ˈbo:li:/ˈbo:lli: and ˈɟa:da:/ˈɟa:dda:. Moreover, as was the case in the triplets, the first vowel has practically the same duration in types B and C, the general average of the

difference for the pairs lə'ka:/'ləkka:, bə'sa/'bəssa:, kə'sa:/ 'kəssa:, də'ba:/'dəbba:, kə'ḍà:/'kə'ḍḍa:, gu'ḍa:/'guḍḍa:, ḍə'pha:/ 'ḍəppha:, sə'da:/'sədda: being only 0.1 cs.

2.7.2 *Intensity*

As for physical intensity, it is general experience that it does not have much to do with stress. This is also the case here. Both type A and B may have higher intensity either on the first or on the second syllable, and there is no evident relation with stress, except to a certain extent for VG, whose first syllable in type B (gə'la:) is often much weaker than the second syllable, whereas the relation is variable and the difference between the syllable peaks smaller in type A. This may be due to the fact that her first vowel is often particularly short in type B. More often there is a certain correlation between intensity and pitch, particularly so that high pitch is combined with high intensity, but there may, on the other hand, be a definite drop in pitch, e.g. in tone 2, without any corresponding drop in intensity.

2 7.3 *Pitch*

There is often a close correlation between pitch and stress. This is, e.g., the case in Danish. In Dogri, which is a tone language, one cannot expect to find a consistent relation in pitch between stressed and unstressed syllables. But, as mentioned in 2.6, according to the auditory impression the position of tone in disyllablic words is determined by stress, so that the tone movement starts in the stressed syllable. This impression is, on the whole, confirmed by a phonetic analysis (carried out by Eli Fischer-Jørgensen). It is particularly evident for tone 2 and 3. In the list used for testing stress perception, VG had spoken the words 'kə'ṛa:, kə'ṛá: and 'pə`ra:, pə'rà: five times each. In the case of tone 2 (the high rising tone), it is very clear that the pitch movement takes place on the stressed syllable. In 'kə'ṛa: the first syllable is high rising, and the second syllable still higher, but level, or slightly rising (or, in final position, rising-falling), in kə'ṛa: the first syllable is level (or slightly rising or falling), and the second syllable starts slightly higher and is strongly rising (see fig. 6).

In the case of tone 3 (the falling-rising tone), a considerable part of the fall takes place on the stressed syllable. In ˈpə`*ra*: about half of the fall takes place on the first syllable and the second syllable continues the steep fall and then rises again (there is only one case in which most of the fall takes place on the second syllable). In pəˈrà:, on the other hand, which has stress on the second syllable, the first syllable is level or slightly falling, and the second syllable starts at the level where the first ends and shows an extensive and rather slow fall, followed by a steep rise (which is less pronounced in final position) (see fig. 6).

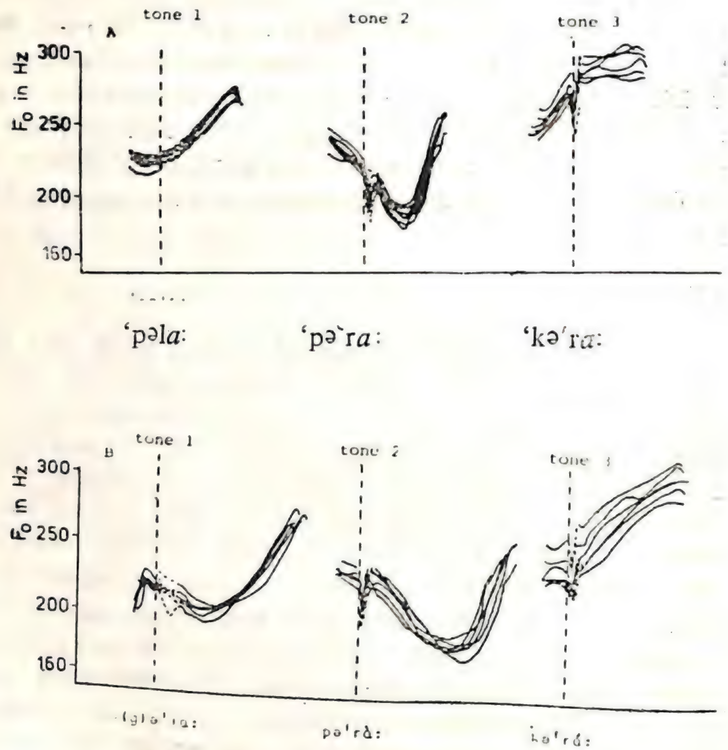


Figure 6

Tracings of words with tone 1, 2, and 3 with stress on the first (A) and the second (B) syllable, spoken by VG. The tracings of six vowels are superimposed. Line-up point: start of the second syllable. The medial consonant is traced in broken line.

This analysis is corroborated by other words of the list. There are four more words with high tone and stress on the first syllable: ˈkhɪ́ṛ*a*: looks like ˈkəˈṛ*a*, having rising pitch on the first syllable and high pitch on the second, ˈká:l*a*: has strong rising pitch on the first *a*:, while the second syllable starts at the level where the first ends and is slightly falling, and in ˈkɪ́ll*a*: the first vowel and the following *l* have rising pitch and the second syllable falling or level pitch. There are also four words with low tone and stress on the first syllable. ˈpɪ̀ṛ*a*: and ˈpà:r*a*: have the whole of the fall on the first syllable (it should be noted that *r* and *ṛ* are very short), whereas pò:li: and tɪ̀ll*a*: have fall on the first vowel, continuing in *l*, and the rise starting in the second vowel. Of the words from list I which were compared for duration, two have falling tone, namely ˈpə`kh*a*: and təˈkhà:. Here VG has not much of a fall in the first syllable of ˈpə`kh*a*:, and also the second syllable is level, but it is obviously lower, whereas in təˈkhà: the first may be slightly falling, but the second syllable starts at the same level as the first and is falling. SD has a clear difference, most of the fall being on the first syllable in ˈpə`kh*a*:, the second being rising or falling-rising, whereas in təˈkhà: it is true that the first syllable is also falling, but the second syllable starts higher and has a much more extensive fall. SL has a similar, but less clear difference (the second syllable of təˈkhà: may start at a lower point than the first). RN has a clear fall in the first syllable and a lower start of the second syllable of both words, but in ˈpə`kh*a*: the second syllable is rising, whereas in təˈkhà: it continues the fall before rising. As for AS and CS, they do not have much pitch movement in these words, and the first syllable is generally level, so that the fall is on the second in both cases, but in type B the pitch generally starts higher in the second syllable than in the first, whereas in the type A it is the opposite. This difference is, however, not consistent.

As for tone 1 (the neutral tone), the relation to stress is less clear. In some cases it is, however, evident. VG's neutral tone normally has a rising pitch movement, starting at a much lower pitch than the high rising tone, and generally beginning with a small fall. If the first syllable is stressed (type A), the lowest point is in the vowel of that syllable; if it is unstressed, the

lowest point is in the second syllable, i.e. the rise has its starting point in the stressed syllable (see fig. 6). This is particularly clear in the words from the test list. This means that if the first syllable is stressed, the whole second vowel is rising; if the second syllable is stressed, the second vowel starts with a fall and then rises. If the intervening consonant is voiced and has a certain length (e.g. *l*), then it can be clearly seen that it is rising after a stressed first vowel and falling after an unstressed first vowel. (This, by the way, is in complete accordance with the pitch movement of *l* in Danish ('bilist vs. bi'list). The same description is valid for the words 'gə*la*:/gə'*la*: and 'pə*la*:/pə'*la*: in list I. It is also valid for the same words spoken by RN, and partly for SD and SL; for the latter two informants there is some overlapping, and SL's curves are, on the whole, very flat. For CS it is only valid for 'gə*la*:/gə'*la*:, for As no clear difference can be seen. In the pair 'bə*ga*:/bə'*ga*: VG, RN, and SD show falling-rising pitch on the last *a*: when it is stressed, exclusively rising pitch when it is unstressed. For 'pə*ta*:/kə'*ta*: the difference is that the first syllable is lower than the second in 'pə*ta*:, whereas it is higher in kə'*ta*:, and the second syllable is falling-rising in the latter word, which again means that the lowest point is in the stressed syllable. This is vallid for VG, RN, and SD, but for SL and CS it is only a tendency, and for AS no difference could be seen.

On the whole, it must be stated that the most adequate description of the relation between stress and tone is that the pitch movement starts in the stressed syllable, whereas the most extensive movement may be in the second, unstressed syllable if the first syl able is stressed and has a short vowel. In a few cases, however, e.g. 'pə`kh*a*:/tə'khá: in RN's pronunciation, where the first syllable has falling pitch in both words, it might be more adequate to say that it is the nucleus of the tone that is on the stressed syllable. This problem deserves a more thorough investigation.

Chapter Three

Consonant gemination and consonant weakening in Dogri

3.1 Introduction

There exists in Dogri an opposition between geminated[1] consonants and single consonants in intervocalic and final positions. Some single consonants are weakened in these positions to such an extent that they change into fricatives, flaps, or semivowels. This phenomenon, which has been referred to casually in previous descriptions of the language, has been studied further in this chapter.

Dogri has twenty-eight consonants :

	Velar	*Palatal*	*Retroflex*	*Dental*	*Labial*
Stops, voiceless	k	c	ṭ	t	p
Stops, voiceless, aspirated	kh	ch	ṭh	th	ph
Stops, voiced, unaspirated	g	ɟ	ḍ	d	b
Nasal	ṅ	ñ	ṇ	n	m
Flaps			ṛ	r	
Lateral				l	
Sibilants		ʃ		s	h
Semivowels		j			

1. *The term "geminated consonant" is used in this chapter as a common designation both for long consonants distributed on two syllables (geminates in the narrow sense) and for final long consonants.*

All consonants except *ṇ j w* can occur in initial position. All consonants except the semivowels *j w* can occur in final position. All consonants except *ʃ r ṛ ṇ j w* can be geminated in medial and final positions. In final positions they are often followed by [ə], which is not phonemic. The phonemic status of *h* is doubtful as it occurs only in a few forms of the verb 'to be' in the past tense, where it can be regarded as an allophone of *th*, and in one word, pɛh*a*, where it occurs in free variation with the dental sibilant *s*. The following minimal pairs show the contrast between geminated and single consonants after short (central) and long (peripheral) vowels.

After short vowels:

ˈkəcc*a*:	'unripe'	ˈkəc*a*:	'bad' (man)
ˈpətt*a*:	'leaf'	ˈpət*a*:	'address'
ˈbəgg*a*:	'whitish'	ˈbəg*a*:	'to flow'
ˈkətth*a*:	'catechu'	ˈkəth*a*:	'story'
ˈsədd*a*:	'invitation'	ˈsəd*a*:	'always'
ˈrəss*a*:	'rope'	ˈrəs*a*:	'soup'
pʊll(ə)	'softness'	pʊl(ə)	'bridge'
ˈcəppəl(ə)	'sandal'	ˈcəpəl(ə)	'naughty'

After peripheral vowels:

ˈɟ*a*:ddi:	'freedom'	ˈɟ*a*:di:	'much'
ˈsi:tt*a*:	'was sewn'	ˈsi:t*a*:	'a name'
ˈbo:lli:	'speech'	ˈbo:li:	'deaf' (woman)
ˈkɛ:dd*a*:	'in prison'	ˈkɛ:d*a*:	'good manners'
ˈr*a*:ɟɟɛ:gi:	'to the king-dom'	ˈr*a*:ɟɛ:gi:	'to the king'

3.2 Historical background

It may be of some interest to know the historical development of geminated and weakened consonants. Ancient Indian works on phonetics, while describing various types of combinations of consonants, refers to two types : "dārupiṇḍa", which refers to the combination of stop + semivowel (literally : 'block of

wood which can easily be broken', and "abhinidhāna" ('close contact'), which refers to the non-release of a consonant when followed by a stop or a pause. Abhinidhāna is described as the checking of a consonant making it obscure, weakened, deprived of breath and voice. The sound which follows the closure of an unreleased stop is called "dhruva" (literally : 'continuance'); it is audible in the case of voiced stops but not audible in the case of a voiceless stop (Allen, 1965).

This indicates that in Old Indo-Aryan there existed consonant clusters of the type stop + stop, and it was observed that the first member of the cluster could not be released and hence lacked some of its features like aspiration and voice. This obscure and unreleased pronunciation of the first consonant of the consonant cluster resulted in assimilation of consonant clusters in Middle Indo-Aryan languages like Pāli and Prākrits. The explosive consonant completely overpowered the implosive if the latter originally belonged to the similar category or a weaker category. If the first member belonged to a stronger category, then the second member was assimilated to the first one. The order of dominance which is found in consonant assimilation is : 1. Stop, 2. Sibilant, 3. Nasal, 4. *l*, 5. *w*, 6. *j*, 7. *r*. Thus we find such assimilation as :

OIA	*MIA*	
bh*a*kt*a*	bh*a*tt*a*	'cooked rice'
utp*a*l*a*	upp*ə*l*a*	'lotus'
s*a*pt*a*	s*a*tt*a*	'seven'
s*a*rp*a*	s*a*pp*a*	'serpent'
c*a*kr*a*	c*a*kk*a*	'wheel'
r*a*śmi	r*a*ssi	'rope'
*ā*tm*ā*	*a*tt*a*	'self'
k*a*ly*a*	k*a*ll*a*	'tomorrow'
mūly*a*	mull*a*	'price'
puṇy*a*	puṇṇ*a*	'good deed'
c*a*tuṣk*a*	c*a*ukk*a*	'square courtyard'

These geminated consonants have been simplified in Hindi and many other modern Indian languages with a compensatory lengthening of the preceding vowel if it was short in Middle Indo-Aryan. Panjabi, Lehanda and Dogri have retained these geminated consonants. In Dogri, this tendenty to gemination has been further extended to certain morphophonemic forms. A single consonant of the base form is generally changed into a geminated consonant in inflectional forms if the suffix begins with a vowel and if the syllabic pattern of the word permits consonant gemination, i.e., if the consonant is preceded by a stressed vowel. Thus, historically, consonant gemination is to be traced back to assimilation of consonant clusters, but now it has become a part of the syllable structure of Dogri.

As regards weakening of intervocalic consonants, the tendency is seen even in OIA. Ṛgvedic spelling "ḷ" for intervocalic "ḍ" and "ḷh" for "ḍh" and occurrence of "ṇ" for 'n' in 'sthaṇu' indicate this weakening (Bloch, 1965). This tendency of weakening intervocalic single consonants increased in the MIA stage along with the tendency of assimilation of consonant clusters. Weakening appeared in the form of voicing of intervocalic unvoiced consonants and vocalization of intervocalic voiced consonants.

OIA	*MIA*	
jā*nā*ti	jā*nā*di	'knows'
*ā*k*āsa*	*ā*g*āsa*	'sky'
k*a*roti	k*ara*di	'does'
m*a*ti	m*a*di	'intelligence'

Change of dental *n* to retroflex, fiapped ṇ as a form of weakening is also very common.

In some Prākrits like Mahārāṣṭrī, the original unvoiced stops were first voiced and thereafter vocalized, thus merging with the original voiced stops. OIA kapi, Mahārāṣṭrī kai.

This development does not seem to have affected the Prākrits from which Panjabi and Dogri are derived.

As regards Dogri, it shows a peculiar development of weak

consonants to fricatives. Sanskrit had no fricatives except *v* and the voiceless sibilants. As regards MIA, the voiced consonants which were changed to glides might have passed through an intermediate fricative stage which is not recorded in writing (Bloch, 1965). North Western Prākrits of the Kharoṣṭhi documents found in Central Asia, however, show the change of the intervocalic consonants *k c ṭ t p* into voiced consonants *g j ḍ d b*, and *k c ṭ p* (and also *g j ḍ b* [?]) further become spirants *g′ s′ (j′) d′ v* (Burrow, 1937). It appears that just as Dogri has preserved some of the peculiarities of the Prākrits of Aśokan inscriptions discovered in North West India at Shāhbāzgaṛhi and Mānsehrā, similarly it has developed fricative-like pronunciations of weak consonants due to its relationship with North Western Prākrits. The area was under the influence of Iranians for some time, and it is possible that North Western Prākrits developed this tendency due to the influence of Iranian. Opposite to the Middle Indo-Aryan in which there is a tendency to assimilation, the Iranian preserves both consonants by changing stop+stop into fricative+stop. The following related words show this difference:

OIA		*MIA*		*Iranian*	
bh*a*kt*a*	'cooked rice'	bh*a*tt*a*	'cooked rice'	b*a*xt	'fate'
s*a*pt*a*	'seven'	s*a*tt*a*	'seven'	h*a*ft	'seven'
p*a*kv*a*	'ripe'	p*a*kk*a*	'ripe'	puxt	'strong'
dugdh*a*	'milk	duddh*a*	'milk'	duxt*a*	'milk
vikt*a*	'empty'			bixt	'empty'
kṣubdh*a*	'angry'			*a*suft*a*	'angry'

Dogri has borrowed various Persian words. While intitial fricatives in such words are changed to stops in Dogri, medial fricatives are generally preserved.

It is interesting to find that some Dogri words show a two-way treatment of OIA consonant clusters, one showing assimilation of the unreleased consonant to the released one, and the other showing preservation of both consonants by fricativizing the first member.

OIA bh*a*kt*a*

Dogri pəˋtt(ə) (cooked rice) — pəˋɣ(ə)t(ə) (worshipper)

OIA rəkt*a*

Dogri rətt(ə) (blood) — rəɣ(ə)t(ə) (a disease)

3.3 The relation to stress and syllable division

An initial consonant evidently belongs to the following vowel, and a final consonant belongs to the preceding vowel. An intervocalic consonant can belong either to the preceding vowel or to the following vowel or to both vowels. In a word like bəg*a* :, the consonant may belong to ə and thus behave like a final consonant detached from the last vowel bəg/*a* : [ˈbə*a*ɣ:]. It may belong to the final vowel *a*: and behave like a syllable-initial consonant : bə/g*a*: [bəˈg*a*:]. It is also possible that it may belong to both vowels. In such a case, the consonant is geminated and the syllabic boundary falls in the middle of the geminated consonant: bəg/g*a*: [ˈbəg:*a*:]. Intervocalic consonants in Dogri, when preceded by a stressed vowel, are generally simultaneous members of two syllables and belong to the preceding as well as to the following vowel. Thus, consonant gemination is closely related to the problem of stress in Dogri.

Stress in Dogri is predictable in some conditions and unpredictable in others (see above). In disyllabic words, the consonant of the second syllable can be geminated if stress falls on the first syllable.

In trisyllabic words, the initial consonant of the second syllable may be geminated if the first syllable is stressed ; the initial consonant of the third syllable may be geminated if the second syllable is stressed ; but no consonant in the word can be geminated if the final syllable is stressed.

Thus the favourable environment for gemination of consonants is :

ˈ(C)V	ˈpʊll(ə)	'softness'
ˈ(C)V—Vː	ˈbəgga:	'whitish'
ˈ(C)V—VC	ˈcəkkər(ə)	'circle'
ˈ(C)Vː—VC	ˈgaːɟɟər(ə)	'carrot'
ˈ(C)V—VCVː	ˈcəkkərɛː	'circle' (oblique form)
(C)VˈCV—	cəˈtənn(ə)	'conscious'
(C)VˈCV—Vː	kəˈṭə̀nnaː	'trousers'
(C)VˈCVː—Vː	cəˈlaːkkiː	'cleverness'

A consonant cannot be geminated in such a environment as :

(C)Vˈ—Vː	bəˈga	'flow'
(C)Vˈ—VːC	bəˈɟaːr(ə)	'market'
(C)Vˈ—VːCVː	bəˈɟaːrɛː	'market' (oblique form)
(C)VCVˈ—Vː	pəgəˈtaː	'pay off'

Words longer than trisyllabics are generally made up of two more units and each unit bears stress according to the pattern to which it belongs.

3.4 Basic grade

Another problem is to decide as to which should be considered the basic or unmarked consonant grade in Dogri ? Are (geminated) consonants shortened under certain conditions, or are (single) consonants lengthened under certain conditions ? Generally, that form is considered unmarked which occurs in a wider environment, while the marked form occurs in a limited environment (Fischer-Jørgensen, 1975). This is difficult to decide for Dogri consonants since we find them in strong grade (phonetically) in initial position, in weak grade in final position (with a few exceptions in which the non-phonemic ə generally appears at the end), and in both strong and weak grades in medial position. Phonetically, [g] of ˈgəla and ˈbəgga is strong, but [ɣ] of baːg and ˈbəgaː is weak. When we examine the problem by taking stress into consideration, we find that single consonants can occur both after stressed vowels and unstressed vowels, while the geminated consonants can

occur after stressed vowels only. Accordingly to this criterion, the single consonant can be considered basic, but it is notable that intervocalically, geminated consonants are far more numerous than single ones.

3.5 The phonetic manifestation of consonant gemination

The duration of single and geminated consonant of words in lists I and II has measured on the the basis of mingographic recordings for 5 informants (RN, SD, SL, CS, VG), who read each list five times. For details of the recordings and measurements, see 1.2 and 2.6. The difference of duration between geminated and single consonants is presented in table 8. Table 8 presents average durations of single and geminated consonants for the subjects RN, SL, SD, CS and VG. The table shows that geminated consonants are approximately twice as long as single consonants. The averages are based on the following words, spoken five times each :

Voiceless, unaspirated stops :

single: ˈcəpəl(e), ˈsəti:, ˈpət*a*:, kəˈt*a*:, səˈt*a*:, ɟət*a*:, ˈkəc*a*:, ləˈk*a*:, sət(e)

geminated: ˈcəppəl(ə), ˈpətt*a*:, ˈkətt*a*:, ˈɟɪtt*a*:, ˈkəcc*a*:, ˈləkk*a*:, ˈsətt(ə)

Voiced, unaspirated stops:

single: dəˈb*a*:, ˈɟ*a*:d*a*:, ləˈd*a*:, səˈd*a*:, kəˈḍà:, gʊˈḍ*a*:, ˈbeg*a*:, bəˈg*a*:, ɟəd(e), gəɟ(ə), ɟəg(e)

geminated: ˈdəbb*a*:, ˈd*a*:bb*a*:, ˈsədd*a*:, ˈɟ*a*:ddi:, ˈkə'ḍḍ*a*:, ˈgʊḍḍ*a*:, ˈgo:ḍḍ*a*:, ˈbəgg*a*:, ˈb*a*:ggɛ:, ɟədd(ə), gəɟɟ(ə), ɟəgg(ə)

Voiceless aspirated stops:

single: ˈtò:ph*a*:, ḍəˈph*a*:, ˈkəth*a*:, cəˈth*a*:, bəˈṭh*a*:, ˈpə̀kh*a*:, ˈtʊ̀kh*a*:, dəˈkh*a*:, səˈkh*a*:, təˈkhà:, tu:ph(ə), cɔ:th(ə), tʊkh(ə), d*a*:kh(ə)

geminated: ˈḍəpph*a*:, ˈtə̀pph*a*:, ˈkətth*a*:, ˈcɔ:tth*a*:, ˈməṭṭh*a*:, ˈpə̀kkh*a*:

TABLE 8

Duration of single and geminated consonants in cs for five informants

	Unvoiced unaspirated		Voiced unasp[illegible]		Unvoiced aspirated		Lateral	
	sing.	gem.	sing.	gem.	sing.	gem.	sing.	gem.
N	45	35	55	60	70	30	20	30
	(SL 40)		(SL 45)					
RN	7.9	14.6	5.4	9.2	10.8	18.1	4.8	11.6
%single/gem.	54		59		60		41	
SL	8.0	13.3	4.3	8.1	7.8	12.7	5.0	11.2
%	60		53		61		45	
SD	7.7	16.1	5.4	12.5	9.7	16.7	4.3	13.9
%	48		43		58		31	

(Table 8 continued)

CS	7.6	13.7	4.9	10.3	10.4	15.8	5.5	10.6
%	55		48		66		52	
VG	8.6	15.3	5.2	13.6	10.6	17.9	5.8	17.2
%	56		38		59		34	
grand mean	8.0	14.6	5.1	10.7	9.9	16.2	5.1	12.9
%	55		48		61		41	

Laterals:

single: ˈbo:li:, ˈkʊli:, ˈkɪl*a*:, pʊl(ə)

geminated: ˈbo:lli:, ˈkə:ll*a*:, ˈko:lli, ˈkʊlli:, kɪll*a*:, pʊll(ə)

The averages are thus general averages comprising words of different types. They have been combined because there did not seem to be any consistent differences between them. There are, however, some exceptions : RN's single final aspirated stops are shorter than his single medial aspirated stops. The former have an average duration of 7.7 cs, the latter 12.0 cs. The same is true of SL. His final aspirated stops have an average duration of 5.8 cs, and his medial aspirated stops of 8.6 cs. All subjects except CS have a somewhat longer duration of aspirated medial stops in stressed than in unstressed syllables. As all examples of the geminated stops are medial, and these words are stressed on the first syllable, it might therefore be more adequate to compare them with single medial stops following a stressed vowel only. This will not, however, make a great difference. The averages for single aspirated stops would be for RN : 11.1 cs (vs. 10.1), SL : 8.1 cs (vs. 7.8), SD: 8.0 cs (vs. 9.7), CS : 10.5 cs (vs. 10.4), and VG : 9.5 cs (vs. 10.8), and the general average will be 9.5 cs (vs. 9.9). SD, SL, and CS also have a shorter *d* after a stressed vowel, but, as there is only one word of this type, it changes the average only slightly. The averages given in the table can therefore be considered as quite representative of the relations between single and geminated stops. A comparison with a number of the same words found in the continued text for RN and SD showed very similar values.

It appears from table 8 that voiceless stops are longer than voiced stops for all informants, and aspirated voiceless stops longer than unaspirated ones, except for SL (the aspiration has been included in the measurements. The closure of the aspirated stops is slightly shorter than that of the unaspirated stops). There is very little overlapping between the individual means for voiced and voiceless consonants, more for aspirated vs. unaspirated ones.

According to Bahri (1969, p. 83), geminated consonants

appear after central vowels (ɪ ᴜ ə) only, and on p. 92 he states that stops "are lenis in medial position after class I vowels (ɪ ᴜ ə) unless geminated, while all the stops are comparatively tense when occurring under high or low tone or with peripheral vowels". This seems to indicate that he would only recognise one type of stop (relatively fortis) after peripheral vowels. But, as mentioned in 3.1, there are—according to my observations—word pairs of the type ˈɟ*a*:di:/ˈɟ*a*:ddi:, ˈsi:t*a*:/ˈsi:tt*a*:, ʻkɛ:d*a*:/ʻkɛ:dd*a*:. In order to deny the existence of such pairs, one might propose three different arguments :

(1) It might be maintained that the vowels before geminated consonants are always central. This is what Bahri says on p. 93 but, as it was shown in 2.3, there is a clear distinction between central and peripheral vowels in pairs like ˈbəgg*a*:/ˈb*a*:ggɛ:, ˈkɪll*a*:/ˈke:ll*a*:, etc.

(2) One might also maintain that the type ɟ*a*:di:, i.e. peripheral vowel plus short lenis consonant, does not exist. In the present material there are only few words of this type, but there are some obvious examples with voiced consonants. The words b*a*:g(ə), l*a*:g(ə), and ká:ḍ(ə) have short consonants in the pronunciation of the five main informants (RN, SD, SL, CS, VG) (see table 9). A comparison with table 7 shows that

TABLE 9

Duration of single and geminated consonants in cs after peripheral vowels

	RN	SL	SD	VG	CS	grand mean
b*a*:g(ə)	3.5	4.4	4.0	5.0	3.4	4.1
l*a*:g(ə)	4.6	5.6	5.2	5.6	4.3	5.1
ká:ḍ(ə)	4.8	2.0	4.0	4.4	4.2	3.9
ɟ*a*:t(ə)	6.4	5.0	5.0	9.6	7.6	6.7
ɟ*a*:d*a*:	4.2	3.6	4.0	4.2	3.8	4.0
ɟ*a*:ddi:	12.2	9.8	12.2	13.6	11.3	11.8
l*a*:g*a*:	9.4	8.0	11.8	8.2	8.4	9.2
l*a*:ggɛ:	10.8	9.9	12.6	12.4	10.6	11.3

the duration of the final consonant corresponds to the average duration for single voiced consonants, and they agree with the duration of e.g. *d* in ɟəd(ə) (general average 5.2 cs) as compared to ɟədd(ə) (11.7 cs). There is one example of final *t* [ɟ*a*:t(ə)] (6.7 cs), which shows the same (cp. table 7 and the general average duration of sət (ə) (7.9 cs) as compared to sətt(ə) (1.4 9cs).

Medially the pair 'ɟ*a*:d*a* (4.0 cs)/'ɟ*a*:ddi: (11.8 cs) shows a very clear contrast is consonant length, which may be compared to gU'ḍ*a*: (4.7 cs)/'gUḍḍ*a*: (12.7 cs) of table 9. The pair 'l*a*:g*a*:/'l*a*:ggɛ: is, however, somewhat different. The *g* of 'l*a*:g*a*: (9.2 cs) is closer to that of 'l*a*:ggɛ: (11.3 cs) and 'ləgg*a*: (11.3cs) than to that of 'ləg*a*: (5.6 cs). Only CS and VG have no overlapping between 'l*a*:g*a*: and 'l*a*:ggɛ:, and SL and SD have considerable overlapping. For this words pair, thus, there is a tendency to confusion.

The material does not contain any examples of unaspirated voiceless stops after peripheral vowels (it was recorded before I had read Bahri's paper), but there are a few examples of aspirated stops after peripheral vowels, viz. 'tò:ph*a*:, 'tò:kh*a*:, and 'cɔ:th*a*:. The latter two were pronounced with geminated stop by all informants. As for tò:ph*a*:, two informants had clearly a short consonant: SL 7.2 cs (his general average of aspirated single consonants is 8.1 cs) and VG 10.4 cs (general average 10.6 cs), but SD (15.4 cs) and CS (14.0 cs) have durations corresponding to their geminated aspirates, and RN's duration is in between his single and geminated aspirates, but he has an example of *ph* after *ə* which is almost as long (14.4 cs) and which overlaps extensively with 'tò:ph*a*:, but which is distinguished from 'ḍəpph*a*: (16.6 cs).

On the whole, the duration of the aspirated stops varies much more than the other consonants, and in this case there really seems to be a tendency to confusion in medial position after peripheral vowels. However, final aspirates as in cɔ:th, d*a*:kh, and tù:ph have, for all informants, the same short duration as those of e.g. tUkh, but the absolute measures are somewhat uncertain here because of the difficulty of delimita-

tion from the following *s* of the frame sentence.

As for the consonant *l*, there is a clear distinction of short and long *l* after peripheral vowels, cf. table 8.

Thus, single consonants, also stop consonants, are distinguished from geminates after peripheral vowels, although there seems to be some confusion for medial aspirates and in the case of *g* in ˈl*a*:g*a*:.

(3) One might maintain that the so-called geminated consonants after peripheral vowels are not really geminates but only fortis consonants, and this is what Bahri seems to ascertain on p. 92. That would probably mean that they should not be much longer than the single consonants but articulated with more force. Table 10 shows consonant durations for eight triplets (five of them with stops) of the type ˈbᵊg*a*:/ˈbᵊgg*a*:/ˈb*a*:ggɛ:. All subjects have been combined since there is no consistant difference between them.

TABLE 10

Duration of geminated consonants in cs after short (central) and long (peripheral) vowels compared to single consonant in triplets. 5 subjects (RN, SL, SD, VG, CS) combined [for the first two triplets 6 subjects (+AS)]

dəˈb*a*:	4.9	ˈdəbb*a*:	11.4	ˈd*a*:bb*a*:	10.8
ˈbᵊg*a*:	4.4	ˈbᵊgg*a*:	12·9	ˈb*a*:ggɛ:	11.2
ˈɟ*a*:d*a*:	4.0	ˈɟᵊdd(ə)	11.7	ˈɟ*a*:ddi:	11.8
gʊˈḍ*a*:	4.7	ˈgʊḍḍ*a*:	12.7	ˈgo:ḍḍ*a*:	10.7
cəˈth*a*:	11.3	ˈkᵊtth*a*:	17.8	ˈcɔ:tth*a*:	15.6
ˈkɪl*a*:	5.3	ˈkɪll*a*:	14.5	ˈkə:ll*a*:	12.5
ˈkʊli:	5.9	ˈkʊlli:	15.4	ˈko:lli:	13.3
ˈbo:li:	5.0	ˈpʊll(ə)	11.8	ˈbo:lli:	11.5

Table 10 shows that the geminated consonants are indeed slightly shorter, on the average, after peripheral than after central vowels [except ˈɟ*a*:d*a*:/ɟᵊdd(ə)]. Of 42 pairs of averages (5 informants × 8 pairs + 2 for AS), 32 show a higher average value after a central vowel. This may not be due to pure

chance; consonants often tend to be slightly shorter after long vowels than after short vowels, but this is a perfectly well-known compensation phenomenon which does not justify ascribing them to two different phonetic categories. Moreover, there is extensive overlapping between single tokens. This is shown in fig. 7 for some of the triplets, all subjects combined; the other triplets look the same (there is slightly less overlapping in kɪll*a*:-ke:ll*a*:). The overlapping is not due to the combination of subjects. When the consonants are compared for each subject separately, there is overlapping in 38 of 42 pairs (the exceptions are VG kɪll*a*:/ke:ll*a*: and kʊlli:/ko:lli: and CS kɪll*a*:/ke:ll*a*.).

The pairs dʊbb*a*:/do:bb*a*:, kʊbbi:/bo:bbi:, sʊtt*a*:/so:tt*a*:, gʊtt*a*:/go:tt*a*: and tɪll*a*:/te:ll*a*: show similar relations. On the

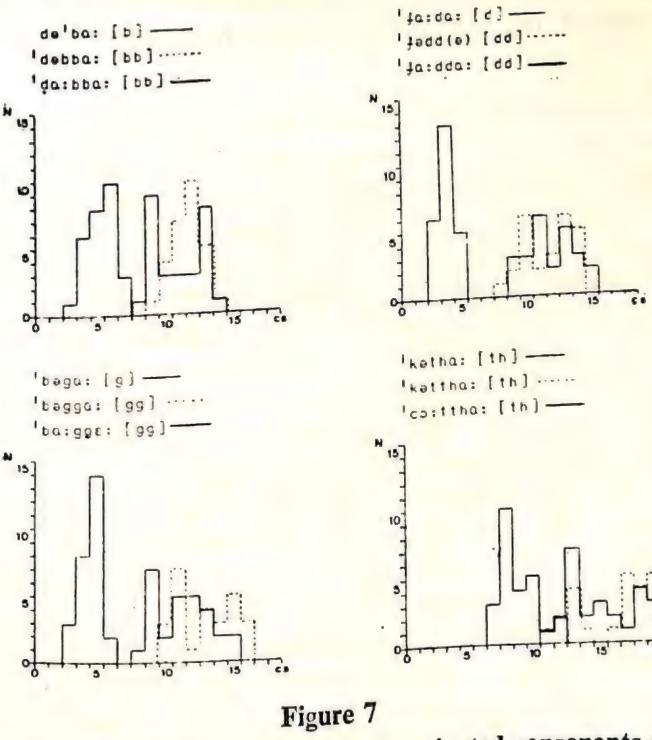


Figure 7

Duration of single consonants and geminated consonants after central and peripheral vowels. Six subjects combined (N=23—28).

other hand, it appears clearly both from table 9 and fig. 7 that geminated consonants after peripheral and central vowels are clearly distinguished from single consonants, even for all subjects combined.

3.6 The phonetic manifestation of consonant weakening

As mentioned in 3.1, there is a tendency to weakening of single intervocalic and final consonants in Dogri. This weakening consists mainly in (1) a shortening of the closure, (2) sometimes a slight voicing of unvoiced stops, and (3) fricativization.

Aspirated unvoiced stops and unaspirated voiced stops are more prone to this weakening than unaspirated unvoiced stops, which are relatively resistant. Retroflex consonants also seem to be less prone to weakening, but retroflex *ḍ* may become a retroflex flapped [ṛ], and dental *n* may become a retroflex flapped [ṇ]. The palatal affricate *ch* may be weakened to [ʃ].

In the following, the analysis will be restricted to labial, dental and velar, stops and only part of the material has been included. For each subject two examples of each consonant were analysed in word initial stressed position and, as far as possible, one example for each of the following positions: word initial unstressed position, syllable initial stressed intervocalic position, syllable initial unstressed intervocalic position, and final position (in some cases no examples were available in the material). The results are given in table 11 for the informants RN, SL, SD and VG combined. The word ph*a*r was taken from a different list spoken in a somewhat slower tempo. For *kh* in stressed word initial position, only two informants had examples and only one example of each word. For the word tò:ph*a*:, the duration measurements of SD and CS have been left out since they evidently pronounced it with geminated consonant. For voiced stops and unvoiced unaspirated stops only the total length, i.e. closure plus open interval, is given since the open interval is short and not influenced by the weakening. The individual averages of the open interval are 1.0-2.2 cs for the voiced stops (shortest for *b*, longest for *g*, but often it cannot be measured

TABLE 11

Examples of shortening and fricativization of stops in medial and final position. Averages for five informants (RN, SL, SD, CS and VG) combined. The ciphers under fricativization indicate the number of cases (listening results for fricativization in parentheses)

(N generally = 25)

position	cons.	word	cs	fricativiz. —	?	+	cons.	word	cs	fricativiz. —	?	+
stress word-in.	p	ˈpətt*a*: ˈpət*a*:	14.2 13.3	25 25			b	ˈbəgg*a*: ˈbəg*a*:	12.4 10.7	25 25		
unstr. word-in.	p	pəˈl*a*:	12.0	23			b	bəˈg*a*:	10.6	25		
stress. syll-in.	p	—					b	dəˈb*a*:	5.5	9 (8	2 1	14 16)
unstr. syll.-in.	p	ˈcəpəl(ə)	7.8	19 (23	5 2	1)	b	ˈdəbək(ə)	4.7			25 (25)
stress. word-in.	t	ˈtə̀ppha: ˈtò:ph*a*:	13.0 13.4	25 25			d	ˈdəbb*a*: ˈd*a*:kh(ə)	12.2 10.7	25 25		
unstr. word-in.	t	təˈkhà:	11.5	25			d	dəˈkh*a*:	11.0	25		

(continued)

(Table 11 continued)

position	cons.	word	cs	fricativiz. −	?	+	cons.	word	cs	fricativiz. −	?	+
stress. syll.-in.	t	sᵊˈ*ta:*	8.2	23 (23	2	)	d	lᵊˈd*a:*	5.9	18 (23	5 1	2 1)
unstr. syll.-in.	t	ˈsəti:	9.2	22	3		d	ˈɟ*a:*d*a:*	4.0	2 (13	7 1	16 11)
final	t	ɟ*a:*t(ə)	7.3	16 (24	7 1	2)	d	ɟᵊd(ə)	5.1	8 (13	3 9	14 3)
stress. word-in.	k	ˈkᵊcc*a:* ˈkᵊc*a:*	13.8 13.6	25 25			g	ˈgᵊɟɟe ˈgᵊl*a:*	12.0 10.8	25 23	 2	
unstr. word-in.	k	kᵊˈr*a:*	11.6	25			g	gᵊˈl*a:*	10.9	25		
stress. syll.-in.	k	lᵊˈk*a:*	8.6	25			g	bᵊˈg*a:*	5.4	12 (11	4 2	9 12)
unstr. syll.-in.	k	—					g	ˈbᵊg*a:*	4.5	1 (1	3 1	21 23)
final	k	ˈdəbək(ə)	7.0	17	3	5	g	b*a:*g(ə)	4.0	7 (7	7 12	11 6)

(continued)

(Table 11 continued)

position	cons.	word	cs clos.	cs open interv.	cs total	fricativization —	?	+
stress. word-in.	ph	pha:r	13.4	7.5	(20.3)	19		
stress. syll.-in.	ph	ḍəˈpha:	6.6	5.2	11.4	14 (9	6 4	5 12)
unstr. syll.-in.	ph	ˈtò:pha:	5.7	7.0	12.8	16 (12	1 1	8 12)
final	ph	tu̖:ph(ə)	4.4 (2)		10.3 (3)	8 (5	7	10 20)
stress. word-in.	th	thò:	10.7	7.6	18.3	23		
stress. syll.-in.	th	cəˈtha:	4.9	6.9	11.8	22 (22	3 2	 1)
unstr. syll.-in.	th	ˈkətha:	4.0	5.9	9.9	17 (19	5 2	3 4)
final	th	co:th(ə)	6.3 (3)	(2)	8.8 (2)	22 (21	2 2	1 2)

(continued)

(Table 11 continued)

position	cons.	word	cs clos.	cs open interv.	cs total	fricativization —	?	+
stress.		kəll(ə)	10.0	6.5	16.5	2		
word-in.	kh	ˈkhəbər	9.0	8.8	17.0	2		
unstr. word-in.	kh	khəˈba:r	8.0	6.8	14.7	22	3	
stress.						11	3	11
syll.-in.	kh	dəˈkha:	4.4	7.4	11.8	(11	1	13)
unstr.						1	3	21
syll.-in.	kh	ˈpəˋkha:			8.8	(2	1	22)
final	kh	tʊˋkh(ə)	9.9		10.6	12	5	8
			(3)		(2)	(12	6	7)

at all), and 1.0-3.2 cs for the unvoiced unaspirated stops (shortest for *p*, longest for *k*). In the case of the aspirated stops, both closure and aspiration are given, but in some cases they could not be distinguished so that the averages for total length may be based on more individual averages than those for closure and aspiration. In final position it was sometimes only possible to measure the closure for some informants, and only the total length for others (the number of the individual averages included is in these cases indicated in parentheses, see e.g. co:th in table 11).

3.6.1 *Shortening*

It appears form table 11 that consonants are shortened in intervocalic and final positions. This is true of all subjects, but VG has relatively little shortening in unvoiced unaspirated stops. For unvoiced unaspirated stops and voiced stops it is the closure which is shortened as long as they remain stops, whereas the short open interval remains unchanged. This corrpropondens to what is found e.g. in many Germanic languages. But it is a characteristic feature of Dogri that the same in the case for aspirated the consonants: the closure is shortened, but the aspiration remains almost the same. In Germanic languages, on the contrary, the aspiration is normally very much reduced in unstressed intervocalic position, so that they become practically unaspirated.

There is also a tendency to shorten consonants in unstressed position. In eight out of eleven comparable pairs, four or five subjects have shorter consonant in unstressed position, but the difference is smaller than that due to position.

3.6.2 *Voicing*

In medial and final position after a vowel the first 2-4 cs of a voiceless consonant are normally weakly voiced. That is, however, not specific for Dogri. It is rare that the whole consonant gets voiced, but it happens in many examples of dəbək(*k*) and in cəpel (*p*), particularly in the pronounciations of SD, CS and SL. It also happens in some cases of tu`:ph(ə), tò:ph*a*:, and ɟ*a*:t(ə).

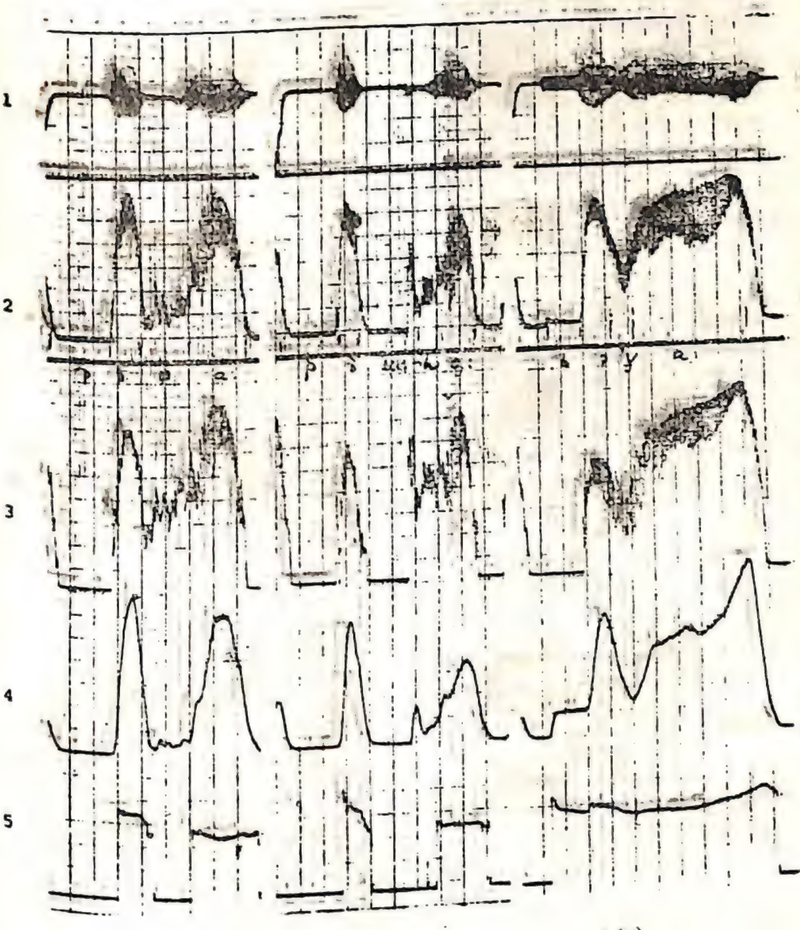
3.6.3 *Fricativization*

3.6.3.1 *Acoustic investigation*

The most characteristic feature of Dogri consonants is the tendency to fricativization in medial and final position, particularly of aspirated and voiced stops. The analysis of this phenomenon was concentrated on acoustic curves since, for all informants, except VG, only tape recordings were available. Acoustically, fricativization should turn up as a weakening of the explosion of the stops and as fricative noise or voiced higher components during the closure of voiceless and voiced stops, respectively. As it is difficult to get a reliable measure of the intensity of the explosion which is very weak anyhow in voiced stops, particularly in *b*, the investigation was concentrated on the appearance of high noise or higher voiced components during the closure. For this analysis the mingographic recordings of all informants were used. They contained an intensity curve with highpass filtering at 2000 Hz (with a steepness of 18 db/octave) added especially for this purpose. High components were expected to show up in this curve, and low frequency noise in the intensity curve high-pass filtered at 500 Hz. The analysis of the curves, however, turned out to be difficult. In the first place, the weakening of stops is a gradual phenomenon and one may find all intermediate steps between firm closure and full fricativization, not only in the time dimension (treated in the preceding paragraph as shortening, of the closure), but also in the intensity of the noise. Thus, there will be cases of doubt, and no real quantization is possible. But the fricativization showed up very clearly in VG's curves. Fig. 8 contains some clear examples: there is noise during the whole medial consonant in/ˈpəˋkh*a*:/[ˈpəˋx*a*:] (fig. 8a) but not in /ˈpəˋkh*a*:/[ˈpəˋk:h*a*:] (fig. 8b), and there are high frequency components and high intensity in the /g/[ɣ] of /bəˈg*a*:/ but not in the /b/[b] (fig. 8c).

However, for the other informants there was noise or, more often, a mixture of noise and voiced consonants where it was not expected. To clear up this problem, a number of spectrograms were taken, and after a thorough comparison of mingo-

grams and spectrograms, Eli Fischer-Jørgensen came to the conclusion that in most cases of noise during the closure in the intensity curve filtered at 2000 Hz, this apparent noise had nothing to do with the consonant but was due to a continuation



(a) (b) (c)

Figure 8

Mingograms of the words (a) ˈpə̀kh*a*:, (b) ˈpə̀kkh*a*: and (c) bəˈg*a*: spoken by VG. 1. duplex oscillogram, 2. intensity curve HP filtered at 500 Hz, 3. intensity curve HP filtered at 2000 Hz, 4. intensity curve full frequency range, and 5. fundamental frequency curve.

of the vowel formants in the beginning of the consonant, caused by some phenomenon of resonance during the recording. This conclusion was bosed on the following facts :

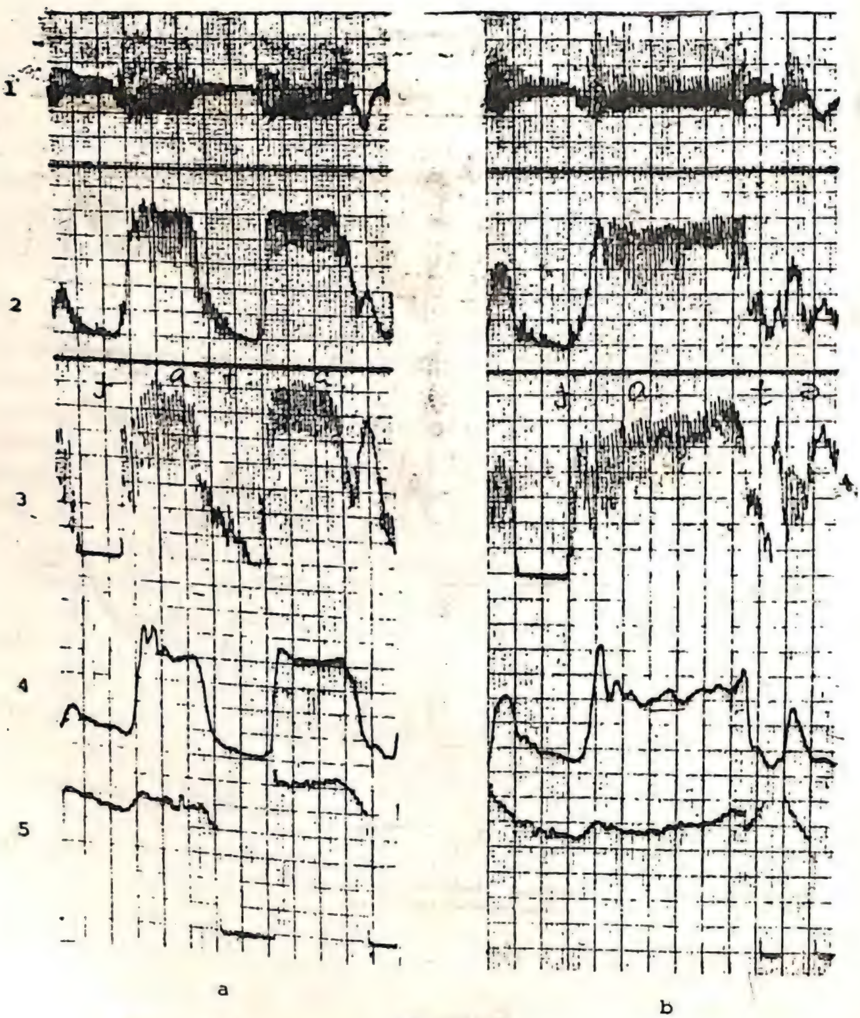


Figure 9

Mingograms of (a) ˈɟa:tta: and (b) ɟa:t(ə) spoken by SD. 1. duplex oscillogram, 2. intensity curve HP filtered at 500 Hz, 3. intensity curve HP filtered at 2000 Hz, 4. intensity curve full frequency range, and 5. fundamental frequency curve.

(1) The noisy components were not only found in the consonants expected to be weakened but also in unvoiced stops and in voiced and voiceless geminates.

(2) The noise started immediately after the vowel and decreased in intensity during the following 5-10 cs.

(3) Its intensity depended on the relative intensity of the preceding vowel, and it was particularly strong for the subjects SD and CS, who have read the text in a relatively loud voice.

(4) The spectrograms showed that it was mostly found at the level of the (strong) first formant of the vowel.

(5) There was nothing to be seen at the frequencies of expected consonant noise, and it cannot be taken for preaspiration either, since aspiration noise is always weak at the frequency of the first formant (but strong in this case) and stronger at the frequency of higher formants. For an example, see fig. 9a ɟ*a*:tt*a*: spoken by SD, and the corresponding spectrogram fig. 10 a.

Figure 10

Spectrograms of (a) ˈɟ*a*:tt*a*: and (b) ɟ*a*:t(ə) spoken by SD.

This type of noise should therefore be disregarded in the interpretation of the curves, and the preliminary results of the acoustic analysis were revised by Eli Fischer-Jørgensen. All noise following immediately after the vowel and showing decreasing intensity, found in the intensity curve filtered at 500 Hz, which contained most of the resonance of the first formant, was disregarded.

With low formant 1 the resonance turns up in the curve high-pass filtered at 500 Hz only, but after *a*: and *ə* (with relatively high first formant) and particularly after *a*: (with a strong second formant around 1100 Hz), it is also found in the curve high-pass filtered at 2000 Hz, and it is difficult to distinguish between real consonant noise and the noise due to resonance, particularly in the cases of short closure.

The words utilized for the analysis of shortening were also utilized for the analysis of fricativization. In table 10, in which the durations are indicated, there is a column for fricativization. "—" means "no indication of fricativization", "+" means "clear sings of fricativization", whereas "?" means "problematic", i.e. some very weak noise is seen in the high-pass filtered curve, or there is strong noise, particularly in the start, and at the same time a clear explosion showing that it is not so probable that the consonant is weakened or, in the case of voiced stops, it may simply be an intermediate case.

A number of cases have been controlled by means of spectrograms, but it was not possible to make spectrograms of all examples. There may therefore be some cases of noise all through in the mingograms which are marked "+" but should have had a "?" or a "—" and, inversely, cases which have got a "—" instead of a "?" or "+", because the noise was so weak that it did not show up in the curves, or it was mixed up with the noise due to resonance. Therefore, the results of a listening test with one Danish phonetician, who listened to each word several times, has been added in parentheses. Here, "—" means "definitely stop", "+" means "definitely fricative", and "?" means "doubt".

It appears from table 11 that the agreement between the

acoustic analysis and the listening results is sometimes very good, sometimes relatively poor. In the latter cases it is not always easy to say whether the curves or the listening is more reliable.

For word initial stops no weakening was found in the curves. There is only one word (khəˈb*a*:r) which seemed to have some noise in the start of the initial *kh* in a few cases (by mistake, this word and the word ˈsəti: were not listened to). Moreover, the *g* in ˈgəl*a*: looked slightly fricativized in a few cases (it stood, exceptionally, after an *l* of the frame), but it was heard as a stop. On the whole, all initial stops were heard as stops, and no listening results are added for these consonants in table 10.

Medial voiceless unaspirated consonants are very rarely weakened, but the final stop in ɟ*a*:t(ə) showed noise in the mingograms in various cases. It was, however, heard as a stop. The listening results turned out to be correct in a number of cases which were controlled by means of spectrograms showing that the noise was due to a continuation of the first and second formants (see fig. 9b and the corresponding spectrogram fig. 10b). On the other hand, the strong noise of the *s* of the frame (where there is no intervening ə), following relatively weak noise, may contribute to hearing a stop.

The aspirated consonants are often fricativized in medial position, particularly *ph* and *kh*. As for the labial consonant *ph*, a fricative (generally a bilabial [ɸ]) was heard in quite a number of cases, corresponding to dubious intensity curves or even to an apparent closure. This was particularly the case for SL. This may be due to the fact that the noise of a bilabial fricative may be rather weak, so that it does not show up in the curves, not even in the spectrograms. Where it does show up (see tò:ph*a*, fig. 11a), it can be distinguished from aspiration by its higher frequency; moreover, the fact that it is strongest in the middle of the consonant distinguishes it both from the resonance phenomenon, which is strongest in the beginning of the consonant, and from aspiration, which shows up at the end.

The dential aspirate does not tend much to fricativization, and there is very little disagreement with the listening results

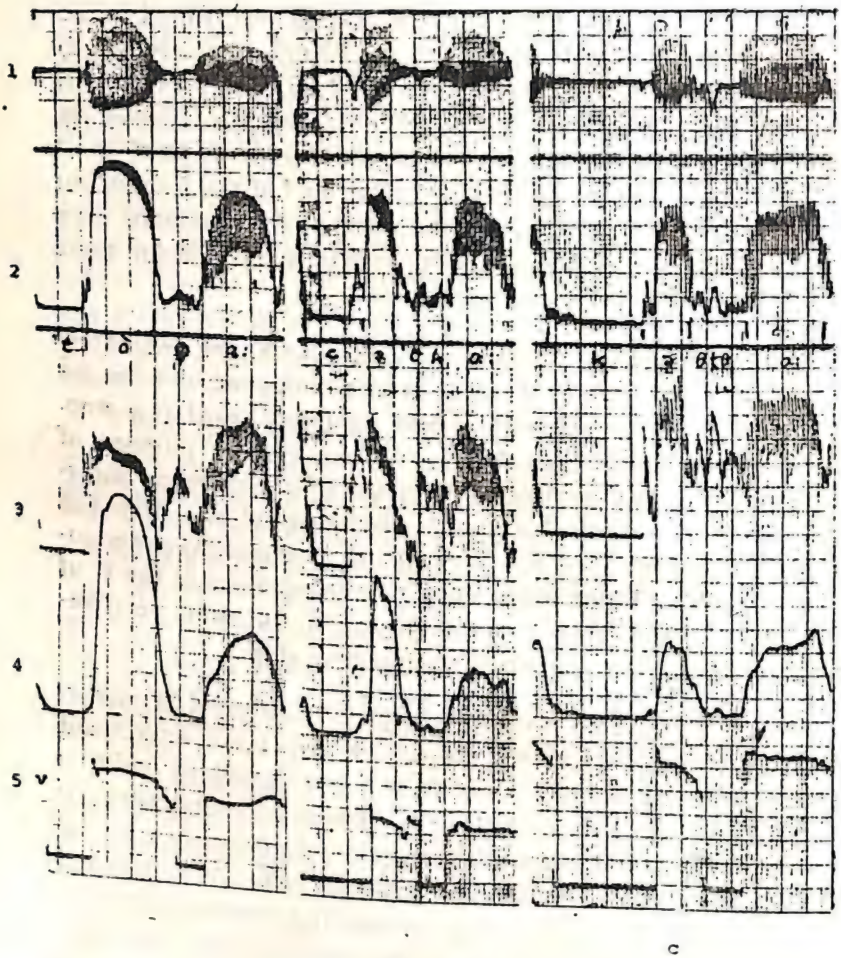


Figure 11

Mingograms of (a) ˈtò:ph*a*: spoken by VG, (b) cəˈth*a*: spoken by CS, and (c) ˈkəth*a*: spoken by SD. 1. duplex oscillogram, 2. intensity curve HP filtered at 500 Hz, 3. intensity curve HP filtered at 2000 Hz, 4. intensity curve full frequency range, and 5. fundamental frequency curve.

for this consonant. There are several cases with strong but decreasing noise going all through the closure in the intensity curve high-pass filtered at 2000 Hz, but showing a clear release. They are heard as stops, and spectrograms show that the decreasing noise is due to a continuation of the vowel formants, cp. e.g. CS's cəˈth*a*: (fig. 11b and the corresponding spectrogram fig. 12b) versus SD's ˈkəth*a*: (figs. 11c and 12c), which has some real high frequency noise and is heard approximately [ˈkəθtθ*a*:].

ˈtò:ph*a*: (a)

cəˈth*a*: (b)

ˈkəth*a*: (c)

Figure 12

Spectrograms of (a) ˈtò:ph*a*: spoken by VG, (b) cəˈth*a*: spoken by CS, and (c) ˈkəth*a*: spoken by SD.

The velar stop *kh* is the one that is most often fricativized, and for this consonant there is good agreement between listening results and acoustic analysis. The frication noise is gene-

rally rather strong. In some cases where a stop is listed, it was affricated rather than aspirated.

Voiced medial and final stops are often fricativized. The agreement between acoustic analysis and listening is very good for *b* and *g* [it was, however, very difficult to come to a decision about the final *g* in b*a*:g(ə)] In the case of ˈɟ*a*:d*a*: and ɟəd(ə) there is an obvious discrepancy, more stops being heard than expected on the basis of the curves (as on the whole in the case of dental consonants), but the stops heard seemed very short. In ˈɟ*a*:d*a*:, like in ɟ*a*:t(ə), the consonant is preceded by a very sonorous vowel, and in some cases the transition from the consonant to the following vowel was very abrupt and the pitch curve had a dip like stops. Thus, there were probably more stops than shown by the ciphers for the acoustic analysis, but a quick movement of the tip of the tongue may, on the other hand, give the impression of a stop even if there is not full closure.

In most cases there is more fricativization (and more shortening) in unstressed than in stressed syllables, both according to the acoustic analysis and to the listening results, cp. the medial consonants of ˈbəg*a*: vs. beˈg*a*:, ˈɟ*a*:d*a*: vs. ləˈd*a*: ˈdepək vs. dəˈb*a*:, (ˈkəth*a*: vs. cəˈth*a*:), ˈpəkh*a*: vs. dəˈkh*a*, but in tȯ:ph*a*: vs. ḍəˈph*a*: it is rather the other way round.

The weakening of single consonants might be seen as a means to avoid confusion with the geminated consonants. However, as seen in table 7, the difference in duration in smallest for aspirated stops, and just in this case there is also less difference in fricativization: ˈtȯ:ph*a*: is weakened both by those who pronounce the *ph* as a single and as a geminated consonant, and SD has complete fricativization of geminated *pph* in ˈḍəpph*a*:, ˈḍepphe, and ˈtə̀pph*a*: and an obvious affrication of *kkh* in ˈpəkkh*a*:, and SL has a rather weak *pph* in some examples of ˈḍəpph*a*: and ḍəpphə.

3.6.3.2 *Prospects of a physiological analysis*

It would have been of interest to undertake a physiological analysis of the weakening phenomenon. This was only possible

in the case of VG, and such an analysis was planned but postponed till after the acoustic analysis, and then it was too late. The only investigations undertaken were a fiberoptic analysis of *p*, *ph* and *b*, and a registration of intra-oral pressure of a word list with labials and dentals spoken in the frame ku:sɛ:... gəl*a*:y*a*:. A preliminary analysis of the fiberoptic investigation, undertaken by Birgit Hutters, showed that the glottis is wide open in *ph*, apparently still more open than in the strongly aspirated Danish stops, although the aspiration is not quite as long as in Danish (for VG around 6-8 cs in the present material). In the unaspirated *p* the glottis is much narrower, but somewhat more open than in Danish voiceless *b*. The wide opening of the aspirated consonant seems to be preserved in the positions of weakening ḍeˈph*a*:, which is in good agreement with the preservation of aspiration found in weak position for all informants.

A preliminary analysis of the intraoral pressure curves undertaken by Eli Fischer-Jørgensen showed that in initial position aspirated consonants had slightly shorter closure but a somewhat higher intraoral pressure than unaspirated consonants (which may be due to the wide open glottis). The voiced consonant *b* and *d* have a much slower rise of the curve, but it may attain the some level as in the voiceless unaspirated stops at the very end. Only labials were used in a list of words with stops in different positions. Neither stress nor position seemed to influence the intra-oral pressure of *p*, and stress did not influence the intra-oral pressure of initial *ph* or *b* either. Nor was there any consistent difference between single and geminated stops. But medial and final weakened *ph* [ˈtò:ph*a*:, tu̖ph(e)] and *b* [ˈdəb*a*: and, partly, gɛ:b(ə)] had a lower intra-oral pressure than initial *ph* and *b*, and since the glottis opening was found to be the same in ˈph*a*:ṛ and ḍəˈph*a*: (and must be practically the same in initial and medial *b*), this points to a larger opening at the lips. The different degree of weakening also influenced the pressure in ˈdəb*a* vs. dəˈb*a* and ˈɟ*a*:d*a*: vs. səˈd*a*:. The relations between stress and duration and between stress and pitch movement mentioned above were fully confirmed in this material.

A palatographic analysis might throw some light on the weakening of the closure of lingual consonants, registration of lip pressure might give some information for the labials, and air-flow curves might give good information about the degree of opening. But this must be done some time in the future.

Chapter Four

Word Tones in Dogri

4.1 Prosodic features

Of the three prosodic features—stress, pitch and vowel quantity—the last is independently phonemic in Dogri as there is contrast between some long and short vowels in non-final position. As regards stress and pitch, both are involved in the tone system of the language.

Dogri, like its neighbouring language Eastern Panjabi, possesses three significant tones which may be described as neutral (tone 1, not marked), falling [tone 2 (`)], and rising [tone 3 (')]. Since 1913 when professor T.G. Baily noticed the existence of significant tones in Panjabi these tones have been described by many writers, but instrumental methods have not been used by any of them. As regards tones in Dogri no study, traditional or experimental, is available as yet.

4.2 Phonological (phonemic) aspect

These three tones have to be regarded as pitch phonemes (or tonemes), because they are the only distinctive features in such sets of words as k*a*:r 'work', kà:r 'house', ká:r 'line'. The meaning differentiated by these tones is mostly lexical but in some rare cases it is grammatical. The verb paṛ occurs in non causal form with tone 3 and in causal form with tone 2. All these tones are word tones in the sense that only one significant tone occurs on a simple word. They can, however, be

described as syllabic tones in the sense that the nucleus of a tone occurs on any one of the syllables in a poly-syllabic word while other syllables are adjusted to the starting point and the end point of the tone-bearing syllable. It is thus not only tone but also the position of the tone which is significant.

o pàr*a*: rd*a*: h*a*:	'he was filling (something)'
o p*a*rà: rd*a*: h*a*:	'he was getting (something) filled'

The syllable containing the nucleus of tone has also stronger stress (including a certain lengthening and a more precise quality of the vowel).

4.3 Historical aspect

Tones are by themselves, like stress and quantity, supra segmental features, but it is interesting to know that tones in Dogri and Panjabi can be traced historically to segmental features. What we perceive as a tone is a mixture of various factors, but its main determinant is the rate of laryngeal vibration which is called fundamental frequency. It is related to such segmental features as voice, aspiration, and glottalization.

The tones of Dogri have nothing to do with the musical accent of the Vedic language, the earliest stage of Old Indo-Aryan, but the stress accent of Classical Sanskrit i.e. a later stage of Old Indo-Aryan has played a role in determining their nature. Stressed syllables in later OIA and MIA are generally preserved in Dogri as syllables with stress as well as tone. If there is no aspiration in the word in the OIA or the MIA stage, the tone is mid level or neutral, i.e. tone 1, but if there is aspiration (generally voiced) in the neighbourhood of the stressed vowel, the tone is either falling, i.e. tone 2, or rising, i.e. tone 3. The aspiration of the voiced aspirated stops of OIA and MIA and of mh nh lh as well as the h sound, which either developed from aspirated stops or sibilants of OIA or existed in words borrowed from other languages, disappears in Dogri giving rise to tone 2 if the stressed vowel follows it and to tone 3 if it precedes it.

Thus intervocalic h appears as tone 2 or tone 3

OIA	ˈloh*a*:	Dogri	ló*a*:	'iron'
OIA	loh*a*ˈk*a*:r*a*	Dogri	luà:r	'ironsmith'

Initial h and final h are replaced by tones 2 and 3 respectively.

OIA	ˈh*ast*a	Dogri	àtth	'hand'
Arabic	sɔˈl*a*:h	Dogri	s*a*lá:	'consultation'

Similar is the case with voiced aspirated stops.

OIA	sv*a*ˈbh*a*:v*a*	Dogri	subà:	'nature'
OIA	ˈl*a*:bh*a*	Dogri	lá:b	'benefit'

The voiced aspirates lose their voice when occurring initially or when preceded by a prefix, but this devoicing may not take place if the voiced aspirated stop is preceded by a prefix which is not realized as a prefix in Dogri, or if the prefix is inconstant in rapid speech.

OIA	ˈbh*a*:r*a*	Dogri	pà:r	'weight'
OIA	pr*a*ˈdh*a*:n*a*	Dogri	pr*a*dà:n	'chief'
OIA	*a*ˈbhy*a*:s*a*	Dogri	byà:s	'practice'

The aspiration of the unvoiced aspirated stops is preserved, but there is a tendency to pronounce the neighbouring stressed vowel with tone 2 or tone 3.

OIA	ˈkh*a*ll*a*	Dogri	khàll	'down'
OIA	ˈkhed*a*	Dogri	khe̖d	'play'

4.4 Instrumental investigation

A preliminary study of tones in Dogri was undertaken by the author under the guidance of professor Eli Fischer-Jørgensen, director of the Institute of Phonetics at the University of Copenhagen. The study is limited for the most part to monosyllabics, although disyllabics and words having vowel sequences have also been considered to some extent.

The speech of five informants—native speakers of Dogri belonging to Jammu Province—has been used. Eighty-six words

of which fifty-three are monosyllabics and thirty-three are polysyllabics including examples of all three tones have been placed in one or two or three of six sentence-frames.

Frame I	ʃail—ai.	'good—is'
Frame II	ʃail—ai?	do., interrogative intonation
Frame III	—ʃail ai.	'—good is'
Frame IV	isi—	'this—'
Frame V	isi—te dikkh.	'this—and see' (isi is an accusative form)
Frame VI	mẽ tusẽ—glā:yā:	'I (to you)—said'

Frames I, II and III have been used for substantives, Frames IV and V for verbs in imperative forms and Frame VI has been used for sets of words belonging to different grammatical categories.

To avoid contrastive pitch, these sentences were arranged in randomized lists which were read twice by each informant. Tape-recordings of these lists spoken by two informants were made in Copenhagen and Stockholm respectively on professional tape-recorders. The rest of the informants recorded the text in India in the studio of Radio Kashmir Jammu.

The instruments used were the Trans Pitchmeter and the Intensity Meter built by B Frokjaer-Jensen of the Institute of Phonetics at Copenhagen University, and the mingograph type 42 made by Elema Schönander (Stockholm, Sweden).

Pitch curves, intensity curves and duplex oscillograms were made from the material recorded on tape. In the case of the pitch curves low-pass filters with cutoff frequencies of 300 (VG), 200 (RK), and 150 (SL, RN, DD) cps were used. Two intensity curves, one linear without filtering and the other logarithmic with a high-pass filter set at 500 cps were made. For male voices a 5 milliseconds' integration time was used in the case of the linear curve and 2.5 milliseconds in the case of the logarithmic curve. For female voices it was 10 milliseconds and 5 milliseconds respectively.

4.4.2 *Discussion of measurements*

4.4.2.1 It is relative pitch and not the absolute pitch which is significant for the perception of tone. The same absolute pitch may be perceived differently as high or low in accordance with the different voice range of different speakers and in accordance with sentence intonation. In the material used in this investigation the voice range of the informants is as follows:

TABLE 1

Voice Range of Informants

Informant	Lowest F_0 in cps	Highest F_0 in cps	Max. range of modulation within one vowel in cps	Mid point of the voice range in cps
VG (Female)	120	400	165	260
RK (Female)	140	350	150	245
SL (Male)	110	250	100	180
DD (Male)	100	405	150	252
RN (Male)	65	210	130	137

4.4.2.2 *Description of tones.* Tone 1 can be described as mid level tone. It starts generally at a point lower than that of tones 2 and 3 and may remain static or fall or rise in accordance with sentence intonation. It is better to describe it in negative terms, because its characteristic feature is absence of the features of tone 2 and tone 3.

Tone 2 is a falling tone which starts at a point generally higher than the middle of the voice range of the speaker and then falls to the lowest point. In the case of vowels of longer duration it generally rises again although this rise depends also on sentence intonation and is individually conditioned.

Tone 3 is a rising or rising-falling tone which starts at a level generally lower than the middle of the voice range and then rises to the highest level or at least to a level higher than the middle of the voice range.

Tables 2-5 contain averages of the fundamental frequency measured at a few points which seemed to be relevant—for tone 1 beginning and end of the vowel, for tone 2 beginning, minimum, and end of the vowel, for tone 3 beginning, maximum, and end. The frame has been measured at a point which seemed to be relatively constant, 10 cs after the beginning of the vowel in ʃail and the beginning of the second vowel in isi.

4.4.2 3 *Cases of similarity between tone* 1 *and tone* 2 *or* 3. Tone 2 shows fall and tone 3 shows rise in all the frames as uttered by all informants, but tone 1 is sometimes similar in contour to tone 2 or 3, and it is necessary to see how it is distinguished from tone 2 and tone 3.

DD's tone 1 in frame I (table 6) shows an average rise from 174 cps to 240 cps and tone 3 in the same frame shows a rise from 197 cps to 288 cps. Thus tone 3 starts at a higher pitch than does tone 1 and rises more than tone 1. Another difference is that tone 3 reaches its highest point sooner than tone 1. The maximum occurs at 23.1 cs (93.1% of the vowel duration) in the case of tone 1, and at 15.3 cs (67.1% of the vowel duration) in the case of tone 3. In the case of tone 1 the rise is generally slow in the first half of the vowel as compared with the second half. In the case of tone 3 it is quicker in the first half. The general level is also slightly higher in tone 3.

RK's tone 1 (table 3) shows a fall in frame I, and it falls even to the same level as tone 2, but as tone 2 starts higher than tone 1, the total fall in the case of tone 2 is far greater (91 cps) than in the case of tone 1 (40 cps). In frames IV and VI tone 1 shows an average rise of 28 cps and 13 cps in contrast with a corresponding rise of 99 cps and 77 cps in tone 3.

In RN's tone 1, the rise in frames IV and VI is 30 cps and 37 cps against the corresponding rise of 67 cps and 88 cps in tone 3 (table 4).

SL's tone 1 is almost static in frame III and may show a slight fall in frames IV and I. The fall however is less (11 cps in frame I and 7 cps in VII). The minimum in tone 1 in frame I

occurs at 7.0 cs from the beginning of the vowel while it occurs at 17.8 cs in the case of tone 2.

VG's tone 1 shows fall or rise in frame I and rise in frames II, III, IV, V, VI, but the occasional fall is much less in tone 1 than in tone 2, and the rise is always slower in tone 1 than in tone 3.

4.4.2.4 *Tones in disyllabics.* The tone-bearing vowel in disyllabics shows the same contour as in monosyllabics, but part of the contour is seen on the second vowel.

4.4.2.5 *Tones in different frames.* Sentence intonation and the position of the test-word in the sentence affect all tones. Both frames I and III are statements, but while in frame I the test-word is placed in the middle, in frame III it is placed initially. The result is: in VK's speech tone 1 is generally slightly falling in frame I and rising in frame III, tone 2 shows a greater fall in frame I, and in tone 3 the second part (falling) is longer in frame I. In the case of DD the difference is only seen for tone 3. Similarly a comparison of frame IV and V shows that tone 1 and 3 give more rise in frame IV, and tone 2 shows more fall in frame IV.

The influence of the sentence types is seen by a comparison between frame I (statement), frame II (interrogative), and frames IV and V which are imperative sentences. Frame II brings about an overall rise of the pitch of all the tones. In frame IV all subjects show a stronger rise in tones 1 and 3 than they have in frame I, and in tone 2 all except RK show a strong rise at the end as compared to frame I.

4.4.2.6 *Individual differences.* DD has a strong tendency toward rising tone. In his case tone 1 is clearly rising and tone 2 is falling-rising in all frames. RK has no rise in tone 2 in frame I and a slight rise in only one example in frame IV.

4.4.2.7 *Influence of surrounding sounds and the quality of vowel.* As expected, the close vowel *i* shows a higher pitch than the open vowel *a*: Generally the pitch starts higher after unvoiced consonants. After unvoiced aspirated stops it often starts lower but shows a quick rise in the beginning. The

preceding voiced consonant does not take part in the relevant tonal movement, but a following *n* or *l* generally continues the movement of the tone.

4.4.2.8 *Vowel length.* The vowel bearing tone 2 is generally longer in duration than the vowel bearing tones 1 and 3, and the vowel having tone 3 is generally shorter in duration than the vowel having tones 1 and 2. The differences are small, but relatively constant.

4.5 Illustrations

Tables 2-6 below (pp. 83-103) are followed by some examples of tone curves (Figs. II, III, V, VIII, IX, XI) drawn from mingograms (cp. Fig. 1). These generally represent the Ist reading (R I). Examples belonging to the same word types have been superposed in the same figure to give a visual impression of the variation. The averages are given below the curves ("beg." = beginning of vowel, "min." = minimum, "max."=maximum). For disyllabics the second syllable has separated from the first by a vertical stroke.

TABLE 2(a)
Informant VG (fem)
Monosyllabics

	Fr	N	Fundamental frequency (cps)					Vowel length (cs)
			Frame	Vowel of test word				
				beg.	rise (+) fall (—)	end	rise (+) fall (—)	
TONE 1								
a:s, k*a*:r, b*a*:r, th*a*:r, s*a*:l, *r*a*:, (s*a*:ṇ), (bel), (m*a*:l)	I	16	205	212		197	—15	35.2
a:s, (k*a*:r), b*a*:r, s*a*:l (th*a*:r), r*a*:, (s*a*:ṇ), (bel), m*a*:l	II	14	202	264		300	+36	32.3

(continued)

(Table 2(a) continued)

a:s, k*a*:r, b*a*:r, th*a*:r, s*a*:l, *r*a*:, m*a*:l, (s*a*:ṇ), (bel)	III	17	188	209			263	+54	32.8	
l*a*:, (g*a*:), p*a*:ṛ, pi:	IV	8	279	221			331	+110	37.6	
l*a*:, g*a*:, p*a*:ṛ, pi:	V	8	234	213			235	+20	36.2	
m*a*:l, t*a*:ṛ, kol, khoṛ, pi:	VI	10		229			260	+31	28.3	

TONE 2					min.					Place of min. (cs)
a:r, k*a*:r, b*a*:r, s*a*:b (r*a*:), (beṛ), s*a*:ṇ)	I	11	210	270	149	—121	155	+6	37.5	30.9
a:r, k*a*:r, b*a*:r, s*a*:b, (m*a*:l), (r*a*:), (beṛ), (s*a*:ṇ)	II	12	206	316	213	—103	227	+14	36.8	26.6
a:r, k*a*:r, b*a*:r, s*a*:b, r*a*:, beṛ, s*a*:ṇ	III	11	196	238	175	—63	207	+32	34.2	23.8
l*a*:, b*a*:, c*a*:ṛ	IV	6	278	285	162	—123	297	+35	43.7	20.8

(continued)

(Table 2(a) continued)

la:, ba:, ca:ṛ	V	6	226	237	145	−92	225	+80	42.0	21.2
ma:l, ta:ṛ, kol, pi:	VI	8		282	184	−98	186	+2	80.5	26.5
TONE 3					max.					Place of max. (cs)
a:r, ka:r, *sa:ṇ, tha:r, da:ṛ, *ra:, (ma:l), (bel)	I	16	206	238	314	+76	233	−81	34.0	15.0
a:r, ka:r, *sa:ṇ, tha:r, da:ṛ, *ra:, (ma:l), (bel), (sa:l)	II	18	205	260	341	+81	318	−23	33.2	18.3
a:r, ka:r, *sa:ṇ, tha:r, da:ṛ, *ra:, ma:l, (bel), (sa:l)	III	18	188	230	334	+104	304	−30	30.6	20.8
la:, ba:, ca:ṛ, pi:	IV	8	270	248	377	+129	373	−4	33.5	
la:, ba:, ca:ṛ, pi:	V	8	231	251	318	+67	208	−110	32.0	13.6
ma:l, ta:ṛ, kol, pi:, khol	VI	10		264	337	+73	327	−10	25.0	19.8

TABLE 2(b)

Informant VG (fem)

Words containing vowel sequences

	Fr.	N	Fundamental frequency (cps)					Vowel length (cs)
			Frame	Vowel of test word				
				beg.	rise (+) fall (−)	end	rise (+) fall (—)	
TONE 1								
r*a*:i, su:i, du*a*:r	I	6	203	226		192	—34	43.5
r*a*:i, su:i, du*a*:r	II	6	183	254		304	+50	46.3
r*a*:i, su:i, du*a*:r	III	6	192	206		281	+75	37.3
n*a*:i, khoi	VI	4		220		269	+49	31.5

(continued)

(Table 2(b) continued)

TONE 2										
					min.				Place of min. (cs)	
du*a*:r	I	2	212	262	140	—122	232	+92	51.0	39.0
du*a*:r	II	1	200	325	210	—115	210	+0	47.0	38.0
du*a*:r	III	2	190	225	175	—50	240	+65	42.0	29.5
n*a*:i, thoi	VI	4		269	171	—98	180	+9	32.0	23.5

TONE 3										
					max.				Place of max. (cs)	
r*a*:i:, su:i:, ɟu*a*:r	I	6	208	231	331	+100	210	—121	41.0	18.0
r*a*:i:, su:i:, ɟu*a*:r	II	6	188	244	353	+109	328	—25	41.3	16.8
r*a*:i:, su:i:, ɟu*a*:r	III	6	170	225	352	+127	290	—62	36.5	20.2
m*a*n*a*:i:, khoi:	VI	4		247	339	+92	289	—50	28.0	18.3

TABLE 2(c)
Informant VG (fem)
Disyllabics

	Fr	N	Fundamental frequency (cps): Frame	Vowel of test word: beg.	rise (+) fall (—)	end	rise (+) fall (—)	Vowel length (cs)	Fundamental frequency second syllabic: beg.	end
TONE 1										
b*a*:ri:, n*a*:ṛi:, p*a*:ṇi:, phor*a*:	I	8	198	239		191	—48	19.4	196	192
b̤*a*:ri:, n*a*:ṛi:, p*a*:ṇi:, phor*a*:	II	8	183	283		279	—4	19.4	304	316

(continued)

(Table 2(c) continued)

b*a*:ri:, n*a*:ṛi:, p*a*:ṇi:, phor*a*:	III	8	186	201			224	+23	23.0		247	245
phoṛ*a*:, m*a*:ṛi:	VI	4		226			218	—8	19.5		239	264

TONE 2

					min.				Place of min. (cs)			
b*a*:ri:, n*a*:ri:, k*a*:ṇi, thoṛi:	I	8	200	275	193	—82	193	+0	20.6	20.6	165	175
b*a*:ri:, n*a*:ri:, k*a*:ṇi, thoṛi:	II	8	186	312	216	—84	216	+0	23.4	23.4	193	298

(continued)

(Table 2(c) continued)

b*a*:ri:, n*a*:ri:, k*a*:ṇi, thoṛi:	III	8	197	224	184	—40	184	+0	20.5	19.6	185	288
m*a*:ṛi, thoṛ*a*:	VI	4		278	195	—83	195	+0	19.5	19.5	183	183
TONE 3					max.				Place of max. (cs)			
d*a*:ṛi:, t*a*:lli:	I	4	203	248	290	+42	290	—0	16.5	16.5	328	204
d*a*:ṛi:, t*a*:lli:	II	4	187	261	331	+70	331	—0	17.0	16.2	350	338
d*a*:ṛi:, t*a*:lli:	III	4	180	230	326	+96	326	—0	16.5	16.5	353	254
m*a*:ṛi, thoṛ*a*:	VI			235	316	+81	316	—0	16.0	15.8	340	301

TABLE 3(a)
Informant RK (fem)
Monosyllabics and words containing vowel sequences

	Fr.	N	Fundamental frequency (cps)					Vowel length (cs)
			Frame	Vowel of test word				
				beg.	rise (+) fall (—)	end	rise (+) fall (—)	
TONE 1								
Monosyllabics:								
a:s, k*a*:r, (b*a*:r), th*a*:r, (s*a*:ṇ), ś*a*:l, r*a*:, (bel)	I	13	242	212		172	—40	19.0
l*a*:, g*a*:, p*a*:ṛ	IV	6		209		237	+28	21.8
m*a*:l, t*a*:ṛ, khoṛ, (kol), pi:	VI	9		220		233	+13	16.9

(continued)

(Table 3(a) continued)

Words containing vowel sequences:										
du*a*:r	I	1		250			160	—90	26.0	
n*a*:i:, khoi:	VI	4		209			224	+15	23.0	
TONE 2					min.				Place of min. (cs)	
Monosyllabics:										
a:r, k*a*:r, b*a*:r, s*a*:n̥, s*a*:b, r*a*:	I	12	238	257	166	—91	166	+0	20.1	19.8
(l*a*:), b*a*:, c*a*:r̥	IV	5		278	150	—128	160	+10	23.0	22.0
m*a*:l, t*a*:r̥, kal, pi:	VI	8		274	175	—99	179	+4	17.7	17.0
Words containing vowel sequences:										
du*a*:r	I	1		225	160	—65	160	+0	25.0	25.0
(n*a*:i), thoi	VI	3		245	183	—62	183	+0	20.0	13.0

(continued)

(Table 3(a) continued)

TONE 3					max				Place of max. (cs)	
Monosyllabics										
a:r, b*a*:r, d*a*:ṛ, th*a*:r, s*a*:ṇ, s*a*:l, r*a*:, (bel)	I	15	241	222	273	+51	247	—26	18.9	13.4
l*a*:, b*a*:, c*a*:ṛ	IV	6		214	308	+94	308	—0	20.5	17.5
m*a*:l, t*a*:ṛ, kol, pi:, khol	VI	10		237	314	+77	307	—7	17.7	15.8
Words containing vowel sequences:										
m*a*n*a*:i	VI	2		245	305	+60	260	—45	22.5	14.5
ɟu*a*:r	I	1		225	285	+60	260	—25	26.0	23.0

TABLE 3(b)
Informant RK (fem)
Disyllabics

	Fr	N	Fundamental frequency (cps)					Vowel length (cs)		Fundamental frequency second syllable	
			Frame	Vowel of test word							
			beg.		rise (+) fall (—)	end	rise (+) fall (—)			beg.	end
TONE 1											
p*a*:ni:	I	2	225			175	—50	12.5		200	192
phoṛ*a*:, m*a*:ṛi:	VI	4	216			193	—23	11.0		218	222
TONE 2				min.					Place of min. (cs)		
k*a*:ṇi:	I	2	267	245	—22	245	+0	11.5	11.5		

(continued)

(Table 3(b) continued)

thoṛa: ma:ṛi:	VI	4	259	195	− 64	195	+0	12.2	12.2	170	210
TONE 3				max.				Place of max. (cs)			
ta:ṇi:	I	2	240	257	+17	257	—0	13.0	13.0	(*)	
(thoṛa:)	VI	1	225	280	+55	280	—0	9.0	9.0	300	

(*) could not be measured.

TABLE 4(a)
Informant RN (masc)
Monosyllabics and words containing vowel sequences

	Fr.	N	Fundamental frequency (cps)					Vowel length (cs)
			Frame	Vowel of test word				
				beg.	rise (+) fall (—)	end	rise (+) fall (—)	
TONE 1								
Monosyllabics:								
a:s, k*a*:r. b*a*:r, th*a*:r, s*a*:ṇ; (r*a*:), (bel)	I	12	87	92		86	—6	25.2
l*a*:, g*a*:, p*a*:ṛ	IV	6		93		123	+30	27.8
m*a*:l, t*a*:ṛ, (khoṛ), kol, pi:,	VI	9		112		149	+37	21.3

(continued)

(Table 4(a) continued)

Words containing vowel sequences:										
du*a*:r	I	1		100			80	—20	33.0	
n*a*:i, khoi	VI	4		93			163	+70	19.0	
TONE 2					min.				Place of min. (cs)	
Monosyllabics:										
a:r, k*a*:r, b*a*:r, s*a*:ŋ, s*a*:b, (ɾ*a*:), (beṛ)	I	12	91	139	74	—65	82	+8	28.0	21.0
l*a*:, h*a*:, c*a*:ṛ	IV	5		150	76	—74	144	+68	32.0	17.0
nʹ*a*:l, (t*a*:ṛ), kol, pi:	VI	7		182	87	—95	134	+67	25.0	
Words containing vowel sequences:										
(dv*a*:r)	I	1		145	80	—65	80	+0	29.0	29.0
n*a*:i, thoi	VI	4		135	84	—51	149	+65	23.5	10.5

(continued)

(Table 4(a) continued)

TONE 3										
					max.					Place of max. (cs)
Monosyllabics:										
a:r, k*a*:r, d*a*:ṛ, (s*a*:ṇ), s*a*:l, th*a*:r, (r*a*:), (bel)	I	13	95	95	141	+46	121	—20	24.6	17.7
b*a*:, c*a*:ṛ	IV	4		116	183	+67	158	—25	26.0	11.5
m*a*:l, khol, (kol), pi:	VI	7		140	228	+88	228	—0	18.6	18.6
Words containing vowel sequences:										
m*a*n*a*:i, khoi:	VI	4		103	204	+101	204	—0	20.5	

TABLE 4(b)
Informant RN (masc)
Disyllabics

	Fr	N	Fundamental frequency (cps)					Vowel length (cs)	Fundamental frequency second syllabic	
			Frame	Vowel of test word						
				beg.	rise (+) fall (—)	end	rise (+) fall (—)		beg.	end
TONE 1										
pa:ṇi:	I	2		95		82	—13	15.0	80	85
phoṛa:	VI	2		90		90	−0	9.0	92	135

(continued)

(Table 4(b) continued)

TONE 2				min.				Place of min. (cs)			
k*a*:ṇi:	I	1	150	110	—40	110	+0	14.0	14.0	80	70
thoṛ*a*:	VI	2	200	102	—98	102	+0	12.5	12.5	87	150
TONE 3				max.				Place of max. (cs)			
t*a*:ṇi:	I	2	130	160	+30	160	—0	18.5	18.5	160	145

TABLE 5(a)
Informant SL (masc)
Monosyllabics and words containing vowel sequences

	Fr.	N	Fundamental frequency (cps)					Vowel length (cs)
			Frame	Vowel of test word				
				beg.	rise (+) fall (—)	end	rise (+) fall (—)	
TONE 1								
Monosyllabics:								
a:s, k*a*:r, b*a*:r, th*a*:r, s*a*:ṇ, s*a*:l, (r*a*:), bel	I	15	146	148		137	—11	26.3
la:, g*a*:, p*a*:ṛ	IV	6		158		158	0	26.8
m*a*:l, t*a*:ṛ, khoṛ, kol, pi:	VI	10		172		165	—7	21.6

(continued)

(Table 5(a) continued)

Words containing vowel sequences:										
na:i, khoi	VI	4		164			169	+5	22.0	
dua:r	I	2		145			135	—10	31.5	

TONE 2

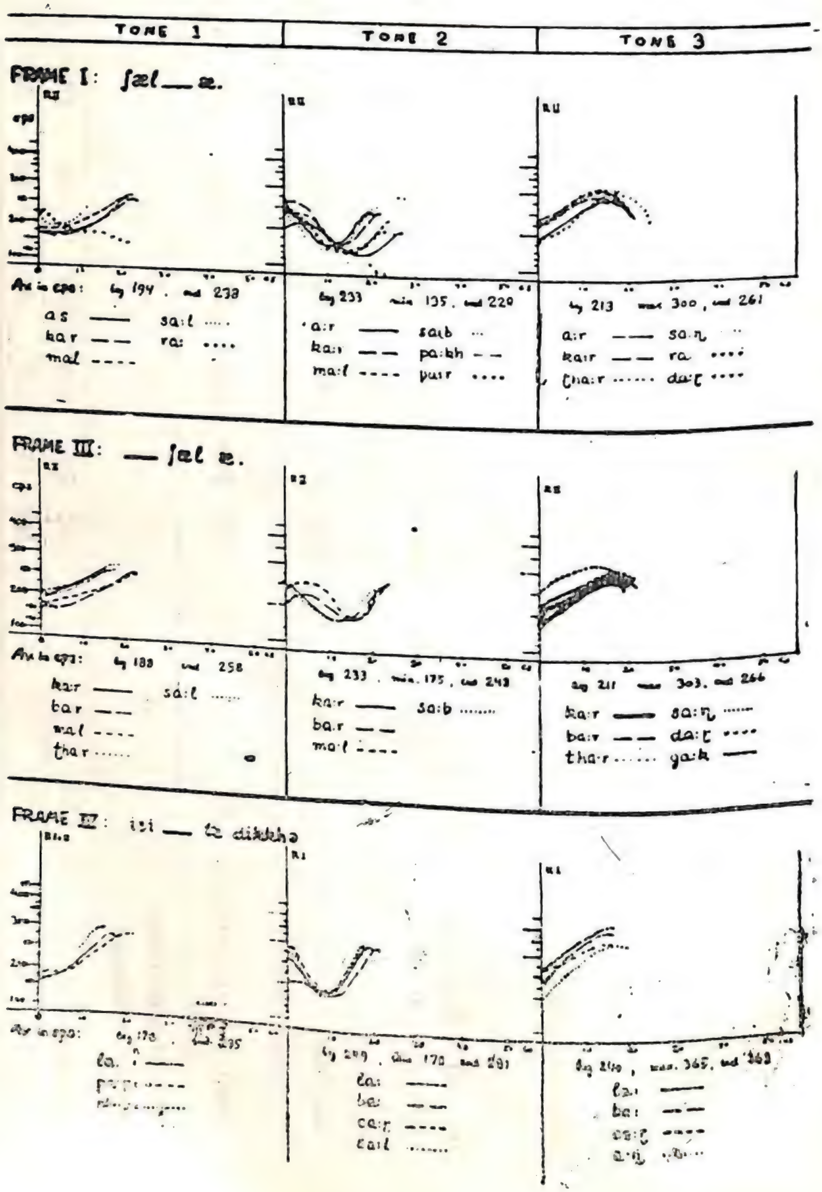
Monosyllabics:					min.					Place of min. (cs)
(a:r), ka:r, ba:r, sa:ṇ, sa:b, (ra:), beṛ	I	12	148	174	122	—52	135	+13	27.7	17.8
la:, ca:ṛ, ba:	IV	6		188	131	—57	150	+19	28.5	16.7
ma:l, ta:ṛ, kol, pi:	VI	10		196	132	—64	138	+6	21.8	15.7
Words containing vowel sequences:										
na:i, thoi	VI	4		193	132	—61	158	+26	25.0	12.5
dua:r	I	2		162	117	—45	131	+14	33.0	23.0

(continued)

(Table 5(a) continued)

TONE 3					max.				Place of max. (cs)	
Monosyllabics										
a:r, k*a*:r, d*a*:ṛ, th*a*:r, s*a*:ṇ, s*a*:l, r*a*:, bel	I	15	146	156	191	+35	169	—22	24.0	16.8
l*a*:, b*a*:	IV	4		158	211	+53	199	—12	23.8	17.5
m*a*:l, (khol), (kol), pi:	VI	6		198	239	+41	239	—0	17.8	17.8
Words containing vowel sequences:										
m*a*n*a*:i, khoi	VI	3		185	235	+50	225	—10	19.0	16.0
ʝu*a*:r	I	2		147	177	+30	167	—10	28.0	23.0

FIG. XI **Informant DD**



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